

ELECTRIC SUPERCARS

780 HP—YIKES!

THE TRUTH ABOUT 4G

ARE THE NEW PHONES
REALLY
WORTH IT?



POPULARMECHANICS.COM APRIL 2011

SCIENCE TECHNOLOGY AUTOMOTIVE HOME OUTDOORS



Popular Mechanics

HOW-TO!

EXTREME

CRAZY STUFF THEY DON'T
TEACH YOU IN SHOP CLASS

LEARN TO:

LASSO A BULL

FIVE STEPS TO SUBDUCE A TON
OF ANGRY, BUCKING MUSCLE



OPERATE A BACKHOE

DIY

- PULVERIZE CONCRETE
 - BLOW UP BOULDERS
 - GRIND STUMPS
 - USE A CHAIN SAW UNDERWATER
- And more!!!*

LAUNCH A CAMERA INTO SPACE

MAKE ROCKET FUEL

+ STUNT-JUMP A CAR AND
SNAP-ROLL A PLANE



BUILD THIS CAR

CATCH A 1000-
POUND FISH



CHECK OUT
OUR iPad
APP TOO!



SIX
COOL
SUPER SHEDS
P. 78



BUILD A SOUP-CAN SURVIVAL STOVE

HORSEPOWER *PER* DOLLAR

IS JUST AS IMPORTANT A MEASUREMENT OF A CAR AS

MILES *PER* GALLON



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PM FEATURES ///
VOL. 188 NO. 4

64

COVER STORY

EXTREME HOW-TO

How to Build a Car

Next-gen auto company Local Motors brings car design to the Web. So, does the cloud know something that eludes Detroit? We build and drive the firm's fierce DIY desert racer to find out.

BY EZRA DYER

Extreme How-To

Your mother definitely would not approve—but our experts show you how. Snap-roll a plane, make rocket fuel from candy, stunt-jump a car and lasso a bull, plus other deeds of derring-do.

What are you waiting for?

BY ROBERT MORITZ

Extreme Tools

To use the door-busting battering ram, you'd need a cop's badge. But the other big, bad instruments on our list are within every man's grasp. Pulverize concrete, blast boulders, or chain-saw a submerged tree trunk.

BY THE EDITORS



78 Super Sheds They're beautiful, functional and miles beyond any prefab backyard shack you've ever seen. These custom-built structures have introduced a whole new level of personalization and quality craftsmanship to the outside storage unit. **BY AMANDA DEMATTO**

84 4G: An Early Adopter's Guide The next generation of cellular data networks is here. But what does the buzz-worthy tech term really mean, and will your service be that much better? We move beyond the hype. **BY SETH PORGES**

88 What Went Wrong: The Disappearance of USA-2 Five days into the world's most ambitious—and treacherous—balloon race, two Americans vanish over the Adriatic Sea. PM investigates. **BY JEFF WISE**

This is the Local Motors microfactory in Phoenix. Can you guess what's being built in there? (Yep, it's big.)

ON THE
COVER

DIY takes on an entirely new meaning with our guide to the most extreme tasks and skills known to man. Seriously. Photograph by Michael Edwards. Prop styling by Terry Lewis, grooming by Spring Super, wrench built by Constructive Display.

The awards are coming into focus.

It's an honor that *DPRReview.com*, *American Photo*, *Popular Photography* and *TIME*[®] Magazine's 50 Best Inventions of 2010 all praised our cameras this year. The **αNEX-5**, the world's smallest and lightest interchangeable lens digital camera* and the **α55**, which shoots up to 10 frames per second and full HD video while maintaining continuous auto focus, have no problem letting their stunning images speak for themselves. But, it is nice to have someone else do the talking.

"My verdict: It's the best travel camera I've ever used."

-Jefferson Graham, USA Today, Aug. 18, 2010



Editor's Choice Award **American Photo**

αNEX - 5



Best of What's New 2010

Popular Science



2010 Breakthrough Product Award

Popular Mechanics

*"It's thrilling to see Sony finding its mojo again,
introducing radical new design ideas that, in this case,
really advance the state of the art."*

-David Pogue, The New York Times, Sept. 22, 2010



Camera of the Year Popular Photography

α55



Gold Award
DPReview.com



50 Best Inventions of 2010
TIME® Magazine

115

Popular Mechanics

PM DEPARTMENTS

NEW TOOLS / CARS / HOME / HOW-TO

Who you lookin' at? Today's home security cameras are networked digital guardians, using advanced software, hardware and cloud-based services.

diy

pm do-it-yourself

× HOME

93 Sod Busters

We test six string trimmers on a gnarly stretch of turf along a paddock fence to see which ones offer the most giddyap and the cleanest cut.

96 Homeowners Clinic

How to revitalize your winter-weary yard and garden.

PLUS Advice on replacing decades-old plumbing valves.

102 PM Saturday

Whether you're in disaster-survival mode or just camping, our cookstove made from two soup cans comes in handy.

× AUTO

105 Saturday Mechanic

How tight is too tight? Here, torquing every nut, bolt and stud on your car just right.

109 Car Clinic

Fixing a faulty fuel gauge to get the correct readout.

PLUS Smoothing the rough idle of a 1998 Chevy S-10.

× TECH

115 Electronic Eyes

Home surveillance cameras keep watch while you're away. We try out models to suit any security level you could ever want.

118 Digital Clinic

Take off the active-shutter glasses and enjoy the new breed of 3D TVs. **PLUS** How to disable your computer's annoying zoom function.

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43 Motown Reborn

Our favorite rides from the Detroit Auto Show. **PLUS** Alt-fuel supercars that push green to the limit; in-car apps.

54 Almost the Future

Jay Leno has some odd rides in his garage, but the rocket-bodied 1963 Chrysler Turbine Car is way, way out there.

58 The Antisocial Network

Criminals are leaving clues on sites like Facebook—and cops are logging on to make cases.

× TECH WATCH

15 Dead-Reckoning Footwear

Engineers build an in-shoe accelerometer- and radar-based system to keep explorers on track when GPS fails. **PLUS** Ultraflexible synthetic red blood cells navigate arteries.

× UPGRADE

25 The Clampdown

The Worx JawSaw chain saw bites down on tree limbs, reducing the injury risk to human ones. **PLUS** How to start your own tablet company (really!); a smarter, greener home.

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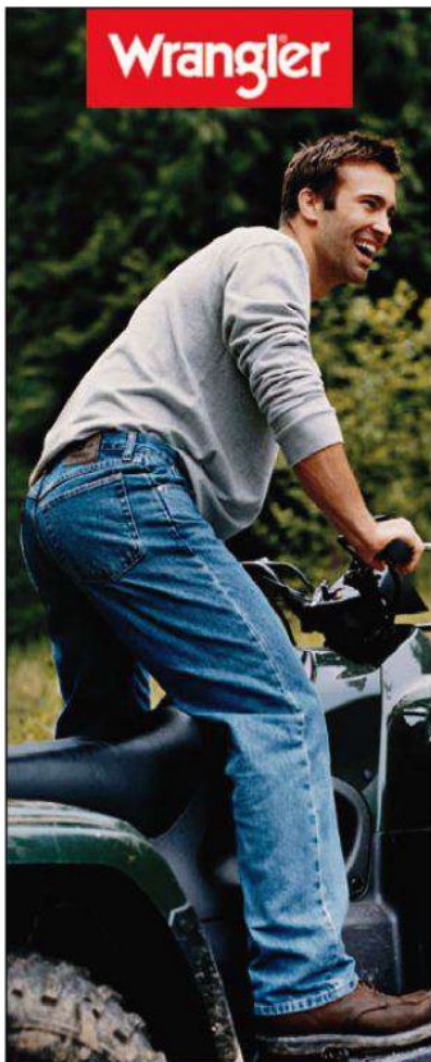
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X APRIL

ADAM SAVAGE & JAMIE HYNEMAN It's no wonder the MythBusters enjoy moonlighting as contributing editors to POPULAR MECHANICS: They blow stuff up for the good of (gonzo) science, take apart cars, preach education, build models and create special effects for movies. Check back for the latest do-it-yourself wisdom from our prolific DIY stars.

popularmechanics.com/mythbusters



DEAN KAMEN He's invented the iBot wheelchair (which spawned his Segway), the Luke prosthetic arm and the Slingshot water purifier. But is he a true tech rock star? To the thousands of competitors in FIRST Robotics, you'd better believe it.

popularmechanics.com/deankamen

BUZZ ALDRIN In 1969, Buzz Aldrin and Neil Armstrong became the most famous astronauts ever. And they still are. When Buzz walks into PM's offices, it's hard to get past the thought, this man walked on the moon.

popularmechanics.com/buzzaldrin

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PM LETTERS

Leaving a Digital Trail

Your February story "Surviving the Digital Swarm," which explores how today's technological devices are invading our privacy, was truly an eye-opener. Anything you put online remains there forever. I did a Google search and was quite surprised to find things I wrote from 1996. We are in the era of Big Brother. There is no escaping it.

PAUL DALE ROBERTS
ELK GROVE, CA

A Mixed-Up Car Cocktail

Your DIY Auto article ("Alcohol Awareness") about the damage that the ethanol in gasoline can do to your car—and how to avoid it—was very informative and up-to-date. As a boat dealer, I've battled these problems ever since ethanol was introduced into U.S. fuel. The old-school practice of storing fuel by topping off the tank is history. Now I buy only enough gas for short-term use. Thanks from a loyal reader for a great magazine!

BILL WITCHER
BRISTOL, TN

The only good thing about E10 is that it generates tax revenue. E10 ethanol caused my 2000 Chrysler T&C fuel-line connector to break in two, my one-year-old Homelite VersaTool fuel line to dissolve and my 50-hp outboard to become damaged. Plus, my chain saw clutch occasionally engages during idling because of E10. Is it really worth it?

RANDY DUTTON
VIA POPULARMECHANICS.COM

NOTE FROM MIKE ALLEN, SENIOR AUTO EDITOR: While the EPA has determined that E10 and E15 are safe to use in any vehicle manufactured since 2000, they're not approved



Feb.

ISSUE
02 / 11

Readers react to our stories about digital privacy, ethanol in gasoline, our boot-drying project and the top-fuel dragster.

for your chain saw, boat or ATV, or for the millions of older cars on the road. So, as more stations switch to the fuels, it will become increasingly hard and costly to find the straight gasoline that these engines were designed to run on.

Cure for Cold Feet

Thank you for the PM Saturday project "The Incubooter." Your boot-drying machine is a hockey player's best friend. With all of the great technology available, there are few solutions that successfully dry icy and sweaty hockey gear. Due to the horrible smell, most equipment stays out in the ice-cold garage, so the Incubooter is a perfect way to dry disgusting, soggy gloves and skates after practice. As I look forward to staying warm each season, I can only hope that other hockey players are also PM readers. Truly a remarkable concept!

CHRIS STREET
GURNEE, IL

PM reader Ken Schulz of Dearborn, Mich., has spent decades building robots. His latest, above, comes in at five feet nine inches and 300 pounds. It can lift 50 pounds with one arm and apparently has excellent taste in magazines.

Get Your Photo in PM!

Caught in the act of enjoying your favorite magazine? **Send us a snapshot of yourself or someone you know reading the latest POPULAR MECHANICS and your photo could be on an upcoming Letters page.** Send a hi-res digital image—or what the heck, send a few—with your name, city and state, and a short note about why you love PM to popularmechanics@hearst.com. We're also featuring a few faves at popularmechanics.com/readerphotos.

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FROM OUR FANS AND FOLLOWERS

In February, PM peeled back the paint of the top-fuel dragster to expose the source of the vehicle's awesome power. In a 3.8-second 1000-foot run, it reaches 300 mph, generates insane horsepower and partially destroys its own engine. Here's some of the buzz.

I never knew it fused the clutch plates together and completely burned out the motor on each run. Rebuilding a motor after each run must be pricey! — DAVID DEMLONG, FACEBOOK FAN

I thought a regular-fuel VW Beetle drag was crazy to have a 6-min life span at 10 secs a run, but the top-fueler's stats? Those are some expensive brag rights! — KEVIN TINOFIREI, FACEBOOK FAN

SHE covers each trip,
there and back.

HE has been riding to
rallies since 1972.



TRIP INTERRUPTION COVERAGE. One thing Charlie St. Clair, Executive Director of Laconia Motorcycle Week, knows is the road can be pretty rough if your bike breaks down. That's why Progressive offers Roadside Assistance for only \$10 a year and Trip Interruption Coverage, which helps pay for places to stay and living expenses due to mishaps, for only \$5 more.* This way, anywhere you are in the country, you're covered. Call 1-800-PROGRESSIVE or call an independent agent.



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SHIFT the way you move



11:38 AM
CALL CENTER

Bluetooth[®] Hands-free
Phone + GPS¹

2:45 PM
DESK

fold-flat, desk-style
passenger seat

9:02 AM
POWER PLANT

powerful 5.6L V8 and
4.0L V6 engine options



3:12 PM
CORNER OFFICE

center console file
and laptop storage² with
optional 120V power

7:15 AM
EXECUTIVE CHAIR

wear-resistant and
water-repellent seats

4:45 PM
STORAGE CLOSET

up to 230+ cubic ft.
of cargo space

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Tech Watch

START

PERSONAL NAVIGATION

Dead-Reckoning Footwear

The satellites of Global Positioning Systems are often unavailable when users need them most: in mountain valleys, in subterranean caverns and in urban canyons where tall buildings block signals. To help people in these situations, DARPA- and Air Force-funded engineers at Carnegie Mellon and North Carolina State universities have developed a tiny radar that attaches to a shoe and measures the distance between the heel and the ground. Coupled with an in-shoe accelerometer and gyroscope, the radar reports how far the user has walked in each direction. Without the radar, the accelerometer would lose accuracy every time the shoe stopped moving. The researchers envision the system integrated into military survival equipment—for example, helping downed pilots navigate to safety—and into gear for adventure sport enthusiasts and first responders. — ALEX HUTCHINSON

QUICK HITS



OF LICE AND MEN

→ Since fabrics don't leave a fossil record, archaeologists can't pinpoint when humans began to wear clothes. University of Florida scientists answered that question by sequencing the DNA from two types of lice. Body lice (*Pediculus humanus humanus*) evolved from head lice (*Pediculus humanus capitis*) after humans began to dress. By determining the

timing of this genetic split, the researchers found that clothes first appeared in Africa as early as 170,000 years ago—roughly at the rapid onset of an ice age. Clothed, humans were able to leave the continent for colder climates. — A.H.

KILLER PAPER

→ Russian and Israeli scientists have invented a new potential weapon in the fight against food poisoning—a paper wrapper that can kill bacteria. They exposed laboratory populations of *E. coli* and *S. aureus* to paper coated with silver nanoparticles. The particles blasted through the bacteria's cell membranes, killing up to 99.9 percent of the populations in just an hour.

— SARAH FECHT

IN THEIR OWN WORDS

“It's becoming quite accepted that we're not going to make it back to the moon before the Chinese.”

BUZZ ALDRIN, *Apollo 11* astronaut

BATTLEFIELD ADVANCES



Snipers Go Solo

→ Military snipers do their job in pairs:

One shooter pulls the trigger, while a spotter watches the result of the first shot to adjust a second. A new system called One Shot, built by Lockheed Martin, replaces the spotter with a laser system that reads the factors influencing a round's trajectory. One Shot analyzes the laser's reflection off particles in the air, such as moisture or dust, to determine wind speed and direction. That data, and information on temperature, humidity and atmospheric pressure, are fed into the spotter scope's processor. The crosshairs in the optical scope shift to reflect the changing conditions. Field tests begin in July. — JOE PAPPALARDO

AEROSPACE HISTORY

FLEET

5 space planes

Columbia, Challenger, Discovery, Atlantis and Endeavour

FIRST DELIVERED

March 1979,
ColumbiaEXPECTED
LAUNCHES

500

ACTUAL
LAUNCHES

135

TOTAL FLIGHT
TIME (AS OF
JANUARY 2011)1289
days,
36 minutes, 29 seconds

SHUTTLES LOST

2

(Challenger,
1986;
Columbia,
2003)TOTAL
PASSENGERS/
CREW

836

ROLLBACKS
FROM
LAUNCHPAD

19

REASON FOR
DELAYMechanical: 10
Weather: 5
Payload: 2
Bird damage: 1
Hail damage: 1

FATALITIES

14

FAILURE RATE

1 in every
67.5
missionsRATE OF
SOLID FUEL
CONSUMPTION
DURING TAKEOFF660,000
pounds
per minuteRATE OF LIQUID
FUEL
CONSUMPTION
DURING TAKEOFF45,000
gallons of
liquid hydrogen
per minute17,000
gallons of
liquid oxygen
per minuteSPEED IN
ORBIT

17,500 mph

TIME TO
ORBIT

8.5 minutes

G-FORCE AT
LAUNCH

3 G's

LANDING SPEED
AT TOUCHDOWN

220 MPH

Shuttle's End

The U.S. space shuttle program, which comes to an end in June, leaves a complicated legacy. No other craft has carried as many crew and as much cargo as the fleet of space planes, but they fell short on promises to lower launch costs. Expensive upgrades, a lapsing mission rate and two fatal accidents mar the shuttle's record. "People don't recognize what an incredible piece of equipment and engineering the space shuttle was," says Mae Jemison, an astronaut who flew on *Endeavour* in 1992. "The magic left after the *Challenger* disaster. We started thinking it's dangerous and stopped thinking we could do difficult things." *Atlantis* is scheduled to perform the final mission, resupplying the International Space Station (ISS). NASA will then buy seats on Russia's Soyuz spacecraft to get astronauts into orbit; U.S. private companies have been tapped to deliver cargo to the ISS.

—ALYSON SHEPPARD



"The vast majority of the shuttle program was a success. We learned so much about how a reusable spacecraft interacts with its environment, how it ages—and what to design next time."

COL. EILEEN COLLINS, two-time shuttle commander and member of NASA's Advisory Council

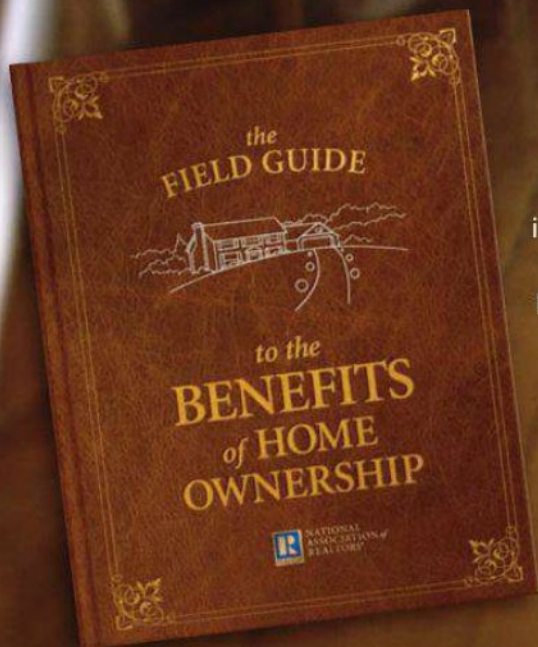
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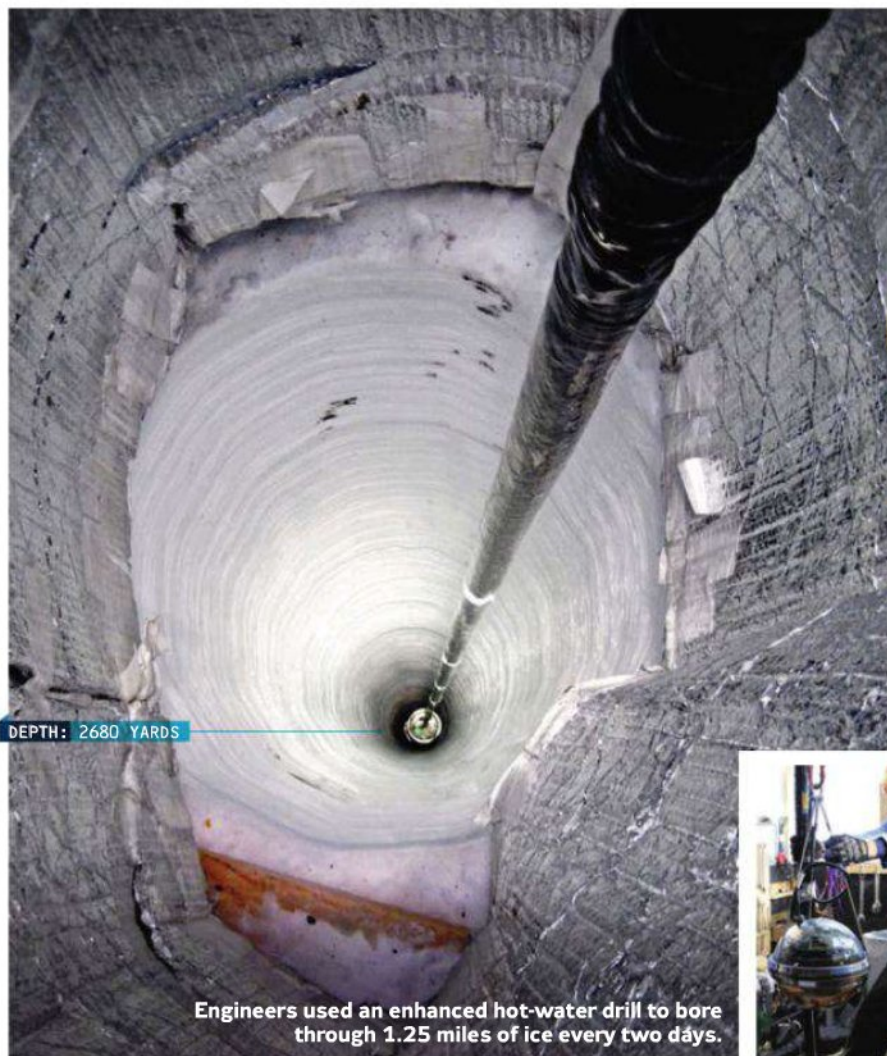
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Icy Observatory Goes Online

Scientists from 10 countries are celebrating the completion of their massive, \$279 million IceCube Neutrino Observatory, located beneath nearly a mile of ice at the South Pole Station in Antarctica. Led by the University of Wisconsin-Madison, the National Science Foundation-funded team drilled 86 holes in the ice. They then lowered a string with 60 sensors into each hole to detect rare collisions between neutrinos from the farthest reaches of space and water molecules locked in the ultratransparent polar ice. The researchers hope to learn more about the black holes and neutron stars where some of the neutrinos originated and also search for hints of elusive dark matter.

— ALEX HUTCHINSON



DEPTH: 2680 YARDS

Engineers used an enhanced hot-water drill to bore through 1.25 miles of ice every two days.

NAVAL TECH Run Silent, Run Invisible



A SUBMARINE'S BIGGEST ASSET IS ITS ABILITY TO REMAIN ELUSIVE. BUT AS POTENTIAL FOES ACQUIRE BETTER DETECTION EQUIPMENT, THE U.S. NAVY MUST CONSTANTLY DEVELOP NEW WAYS TO HIDE SUBS. — A.H.

1. Lurking in the Shadows

Squid, octopus and cuttlefish have light-sensing proteins called opsins that adjust the animals' skin patterns to match the light and color around them. A joint team of university researchers, working with the Marine Biological Laboratory in Woods Hole, Mass., and the Office of Naval Research, is developing nanomaterials that, like opsins, can sense light and rapidly change color to defeat detection by satellites, aircraft or on-deck observers.

2. Sonar Stealth

Engineers at the University of Illinois have built an acoustic cloaking device that guides sound waves around an object, making it invisible to sonar. The disc prototype is grooved with concentric rings that capture incoming sound waves and send them into a spiral instead of bouncing back toward their source, which means there's no sonar echo. Another potential use: creating filters that reduce interference during medical ultrasound imaging.

3. Masking Invisible Waves

The magnetism of a sub's hull increases as it moves through water, leaving a signal that airborne sensors, mines and torpedoes can use to target it. Every year, the Navy erases these magnetic signatures by running high electrical currents through copper cables strung across subs' hulls. Now, Navy engineers are building a "drive-in" facility in Hawaii with a permanent frame and wiring that can demagnetize the hulls quickly. The facility opens in 2013.

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f t y GET CONNECTED

21ST-CENTURY
MEDICINE**Let the Fake
Blood Flow**

Scientists at the University of North Carolina (UNC) at Chapel Hill have overcome one of the key barriers to producing synthetic blood. Red blood cells are soft, which allows them to squeeze through narrow blood vessels and tiny pores. But so far, man-made blood particles created from polymers have been too stiff—they quickly get stuck and are filtered out of circulation. The UNC team is using ultraflexible hydrogels to make particles that could navigate the human body, transporting oxygen. The researchers also hope to adapt the hydrogels to deliver nano-doses of drugs throughout the body.

CIVIL DEFENSE

**Gimme
Shelter**

The demand for well-stocked fallout shelters has receded since the end of the Cold War. Today, another nuclear risk looms—a terrorist cell detonating a single nuclear weapon in a major city—and it requires different preparedness. In 2010, the U.S. government released a 130-page publication designed to help local officials plan for the explosion of a 10-kiloton weapon. The publication instructs survivors (anyone outside the blast radius) to shelter where they are, preferably in a basement or other underground space. It recommends waiting at least 12 hours before emerging; fallout drops by 90 percent within 7 hours of detonation. Not all experts agree with the shelter-in-place campaign. Joseph Cirincione, the author of *Bomb Scare: The History and Future of Nuclear Weapons*, says firestorms could turn such shelters into coffins. "The only true defense against a nuclear attack is to prevent it from happening in the first place," he says. — SHARON WEINBERGER

LIVING ROOM TO FALLOUT SHELTER

☑ A basement or underground area is the best location to hide from nuclear fallout, but what if you're stuck aboveground? Janet Liebsch of Fedhealth, a Tucson-based publisher of disaster guides, says people in that situation should build an "expedient shelter." Here's how:

Step One:

Find a solid table, desk or workbench that is tall enough to fit survivors and supplies.

Step Two:

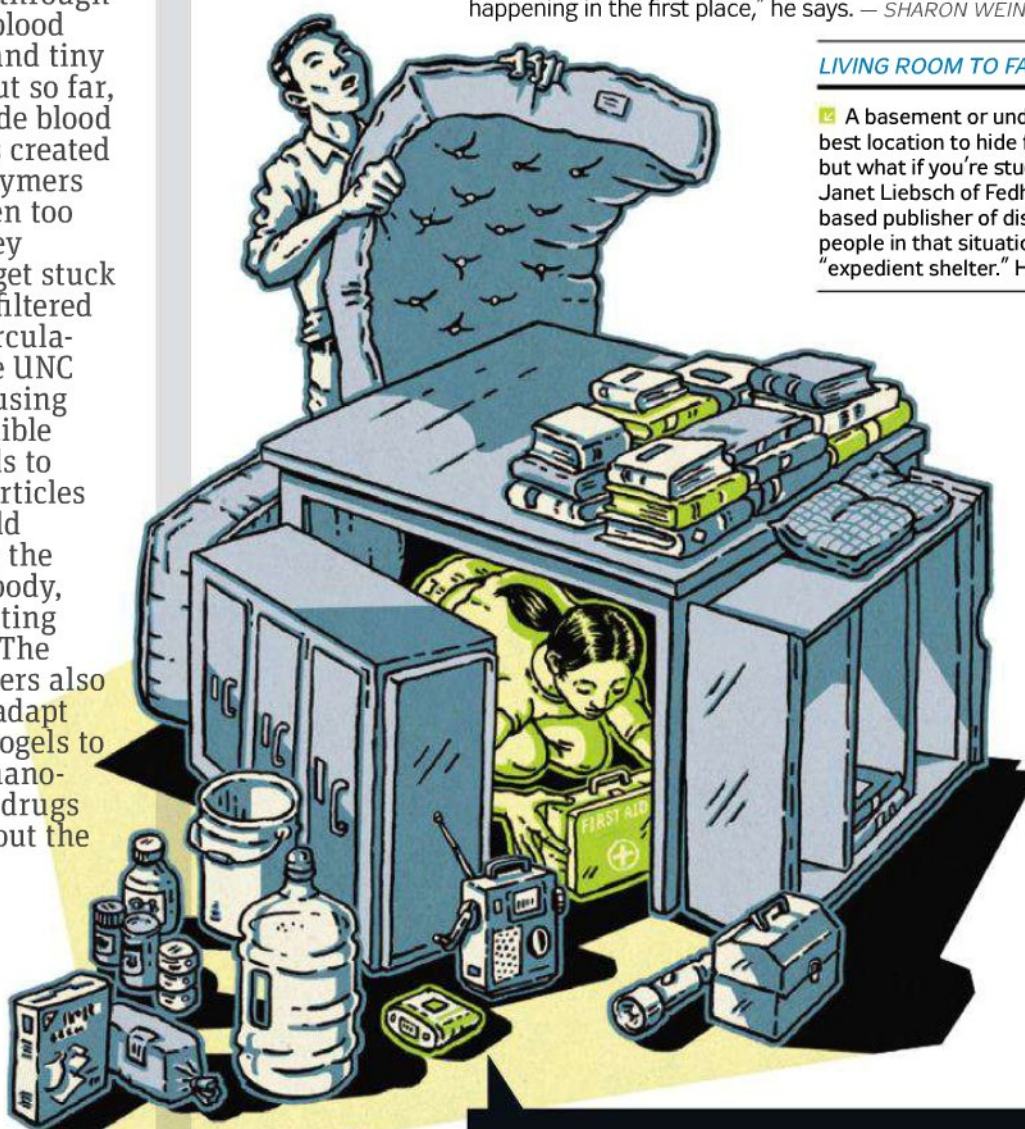
Surround it with shielding, such as books, mattresses or furniture. Several inches of protection is enough to block radiation.

Step Three:

Gather your supplies in the shelter. Don't go overboard—you may only need 12 hours' worth.

Step Four:

Block the entrance, but include two small vents for air.



SUPPLIES: **Hand-cranked radio:** Listen for updates on fire and radiation risks. **Bucket:** Use for personal sanitation. **Medicine:** Fill prescriptions so that you always have a few days' worth. **Food:** Opt for snacks and bottled water. **Dosimeter:** Emerge when the pen-size device detects low ionizing radiation; a safe level depends on how long it will take to find new shelter.

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MEDICAL FRONTIERS

Brain Games

RESEARCHERS CONVERT THE CLASSIC VIDEO GAME *TETRIS* INTO AN INSTRUMENT THAT PROBES THE HUMAN MIND. — OLIVIA KOSKI

Last year, Oxford scientists used the computer game *Tetris*, in which players guide geometric shapes called tetrominoes into place as they fall, to explore how the brain can be manipulated to protect trauma victims from terrifying flashbacks. In fact, scientists have been using *Tetris* to probe the secrets of the brain for nearly 20 years. So what makes it such a good tool for neuroscience? "It has a simple set of rules," says Richard Haier, a psychologist who first stumbled across the game in a software store in 1991. "Yet every move requires a complex combination of concentration and attention, visual and spatial processing."

THE STUDY

Can intervention prevent symptoms of traumatic stress?
PLoS ONE, 2010



THE METHOD

Oxford scientists exposed 60 volunteers to gory films. Afterward, one-third played *Tetris*, one-third sat quietly, and the rest played computer trivia games.



THE RESULTS

The *Tetris* players experienced fewer flashbacks than both of the other groups. This implies that a visual-spatial task, which competes for the cognitive resources required to make mental images, may prevent the development of involuntary memories directly after a traumatic event.

THE STUDY

Does practice make the brain more efficient?
BMC Research Notes, 2009



THE METHOD

A team led by Richard Haier (and funded by Blue Planet Software, the license holder for *Tetris*) conducted a study involving 26 teenage girls; 15 played *Tetris* for 1.5 hours a week for three months.



THE RESULTS

MRI scans showed that the brain function of *Tetris* players became more efficient over time than the control group's. Scans also showed increased cortical thickness in multiple areas, providing evidence that the brain's structure can change with stimulation.

THE STUDY

Can taking action reduce the need for internal computation?
Acta Psychologica, 2008



THE METHOD

Paul Maglio of the IBM Almaden Research Center in California led a series of experiments in which subjects were shown previews of tetrominoes before playing *Tetris*.



THE RESULTS

Players reacted more quickly during *Tetris* when they saw multiple orientations of shapes prior to playing the game. This supports the theory that actions taken in the external world can help the brain process information more quickly, improving performance.

TECH CULTURE Tricks of the Train



→ The bulk of the action in the movie *Source Code*, out April 1, takes place on a doomed commuter train. There, Army pilot Colter Stevens (Jake Gyllenhaal) must repeatedly relive, through a computer program called the Source Code, the last 8 minutes of a dead man's life in order to discover who placed a bomb on the train—and prevent a second tragedy. Director Duncan Jones and his crew considered shooting on a moving train, but realized that this would limit the director's ability to control the camera angles. So the Montreal-based crew built half of a double-decker carriage and mounted it on a pneumatic platform programmed to mimic the movement of the real thing. "The downside was the noise of the compressor," Jones says. "But we kept it outside the studio." The set was designed for easy deconstruction and assembly. "When we wanted to shoot the other side of the train, we'd re-dress it," he says. "That allowed us to move the cameras in ways that wouldn't have been possible on a real train." Beyond the set was green screen, which filmmakers later filled in with footage shot in Chicago, carefully matched to the camera angles shot on set. — ERIN MCCARTHY

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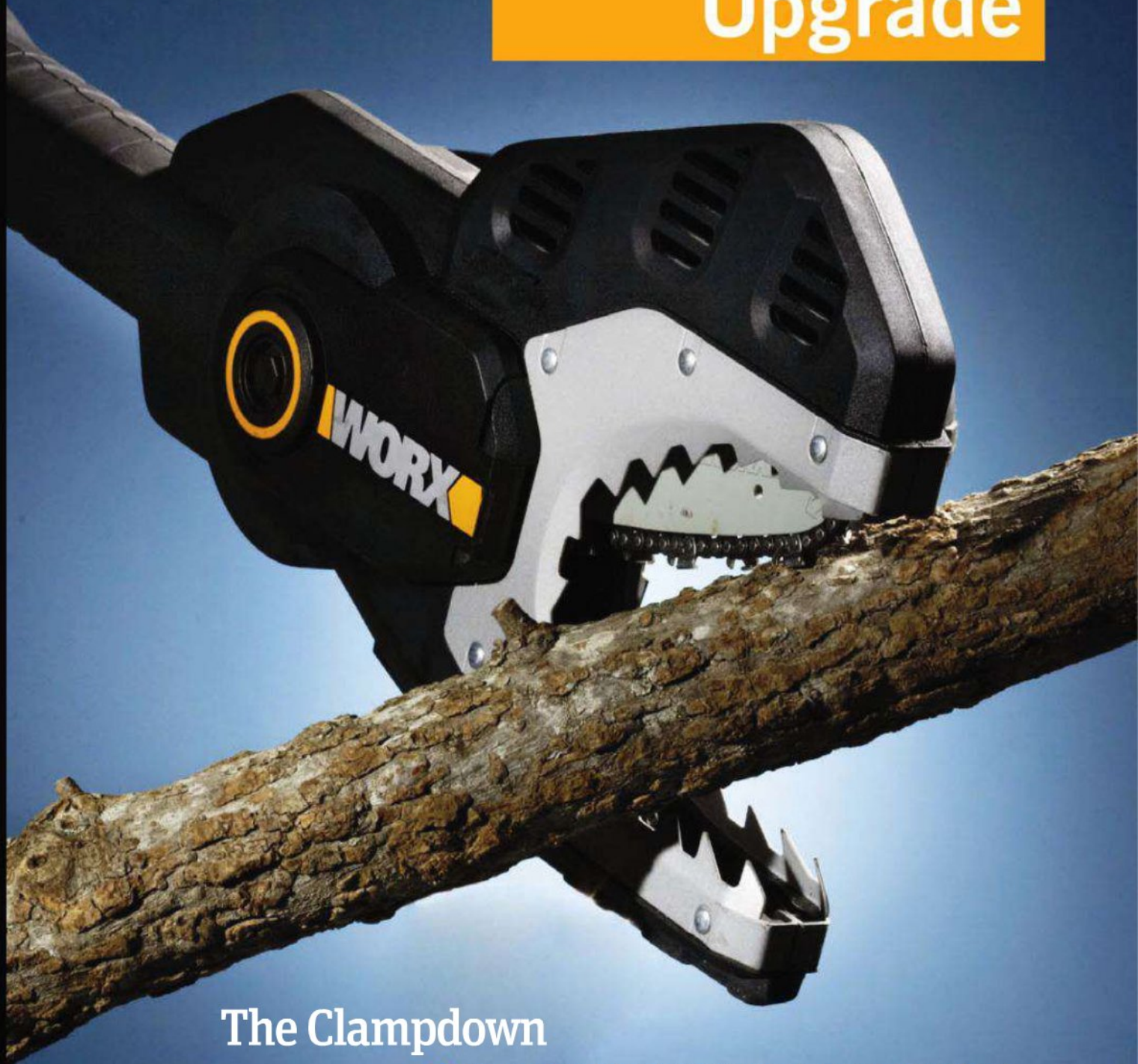


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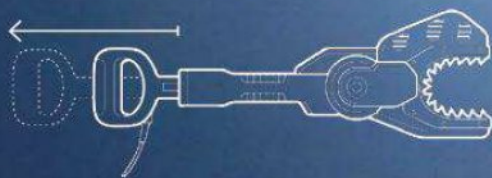

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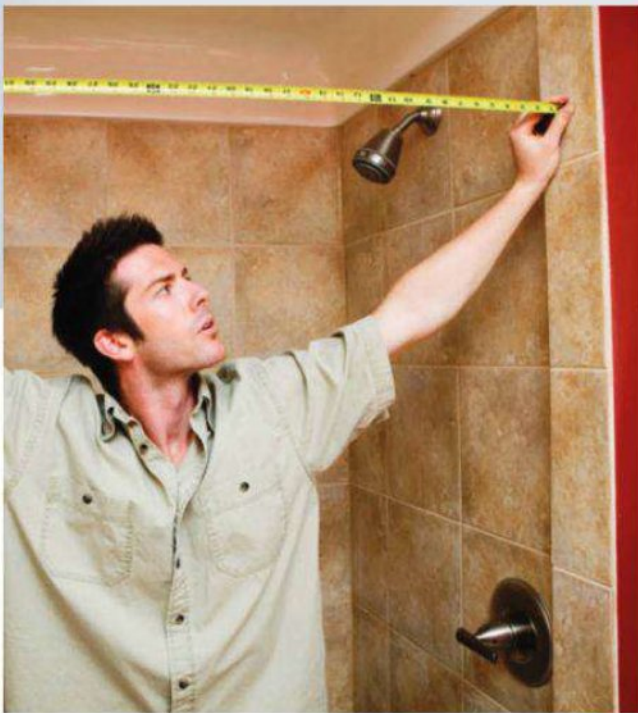
The Clampdown



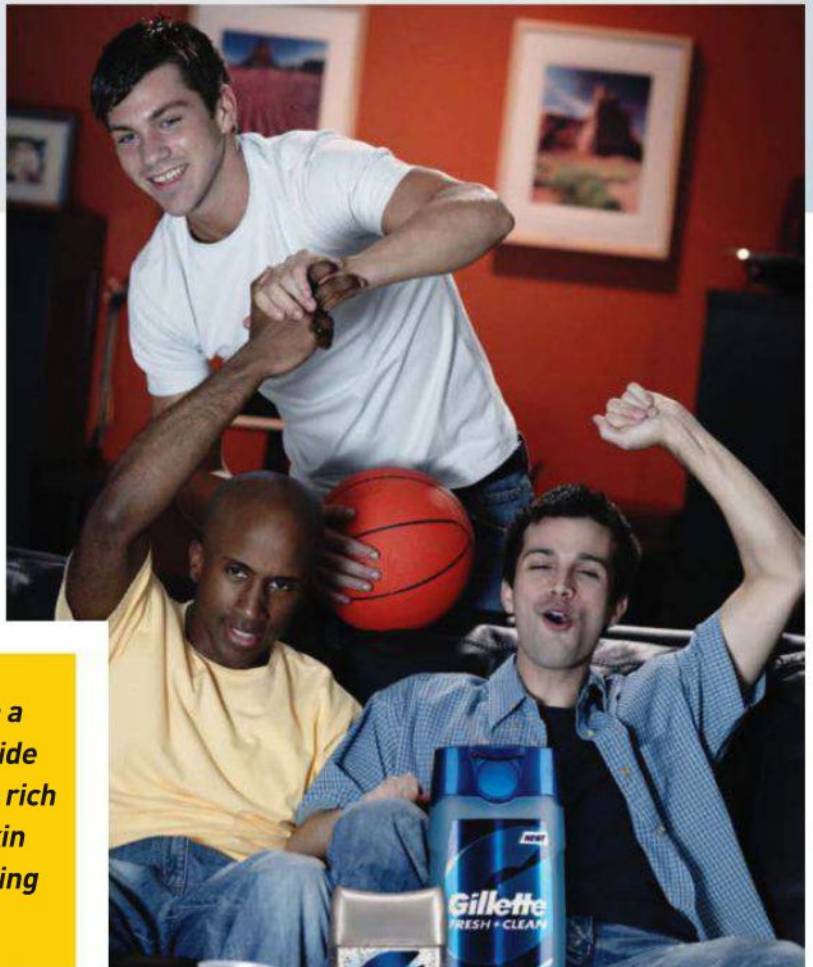
→ Chain saws bite. In fact, their spinning chisels send almost 30,000 people to the ER every year. The **Worx JawSaw (\$120 to \$150)** also bites—but in a good way. Its toothy jaws secure branches up to 4 inches in diameter and safely enclose the blade while it does its business. The JawSaw makes fast work of fallen limbs and cuts like a demon, with an optional telescoping handle that provides a 12-foot, Inspector Gadget-like reach. It may not be perfect for precise pruning close to the branch collar, but for speed and safety, this tool rates. — SETH PORGES

Gillette Fresh + Clean Gives You the Game Day Advantage of Feeling Cool & Confident Beyond the Shower

IT'S THE DAY OF THE BIG GAME, AND YOU HAVE A TO-DO LIST THAT'S AS LONG AS YOUR ARM. BEFORE YOU GET STARTED, MAKE SURE YOU USE GILLETTE FRESH + CLEAN BODY WASH.



To take on any chore or project start your day by using Gillette Fresh + Clean Body Wash.

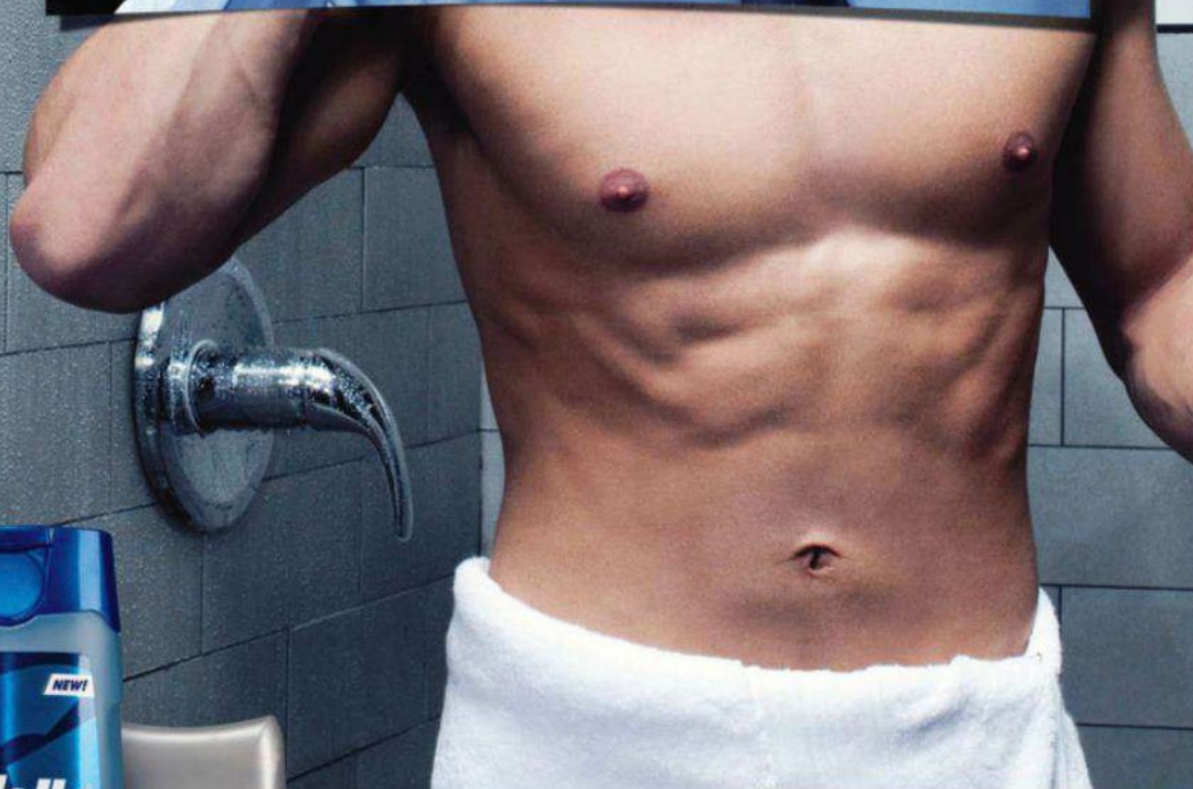
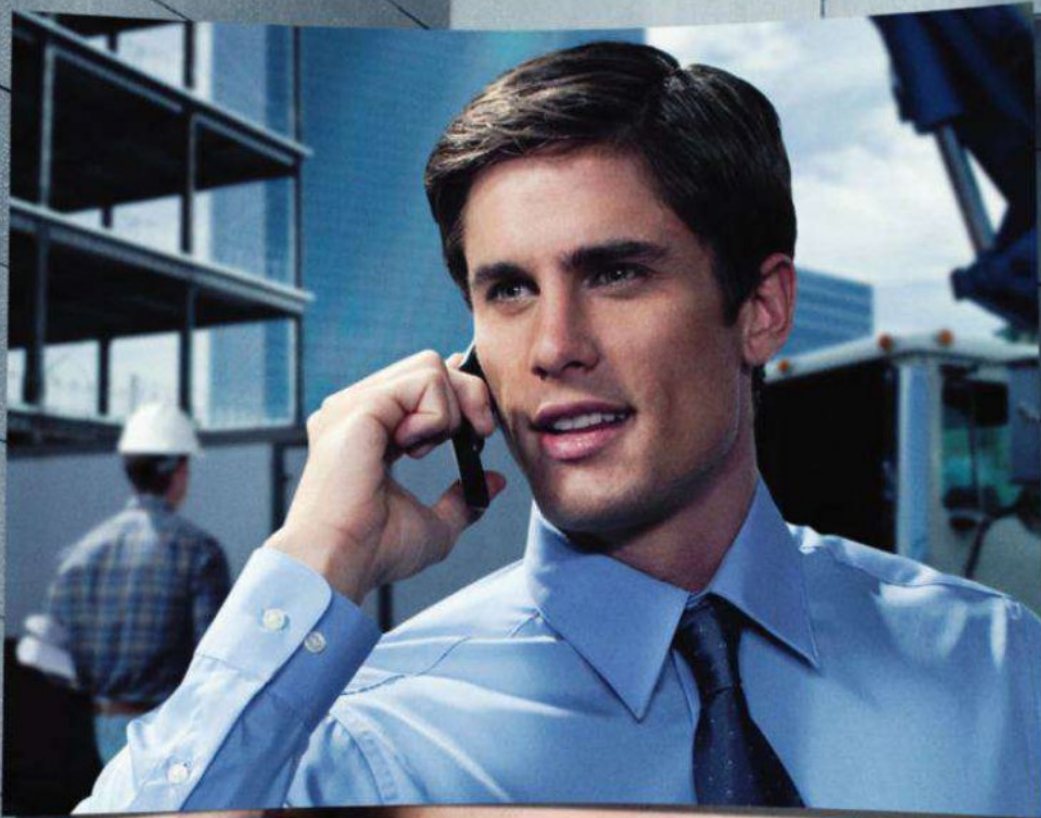


Gillette Fresh + Clean Body Wash scores big with a Triple Freshness System. It's engineered to provide freshness that extends beyond your shower. The rich lather cleans away dirt and odor, leaving your skin feeling refreshed. It comes in a lasting, invigorating Cool Wave or Arctic Ice scent.

So, when you've got the last nail hammered, and only minutes to spare before the big game starts, don't hesitate to join the gang and watch. You started your own game day with the best defense—Gillette Fresh + Clean Body Wash. Use with Gillette Clear Gel Anti-Perspirant/Deodorant for total body freshness. You'll still be fresh and clean well past the final score.



Learn more about Gillette's Fresh + Clean products at www.gillette.com.



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Gillette
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EDITORS' CHOICE

Border Patrol

↑ Goodbye, bezel! With its picture frame shrunk to a barely there 0.2 inches, the **Samsung 8000 Series LED TV** (starts at \$2800) makes moving images appear to hang in midair. But don't be fooled by the pretty design: This puppy is packed with functionality, such as 3D and connectivity to Skype and Facebook.

**Staying Current**

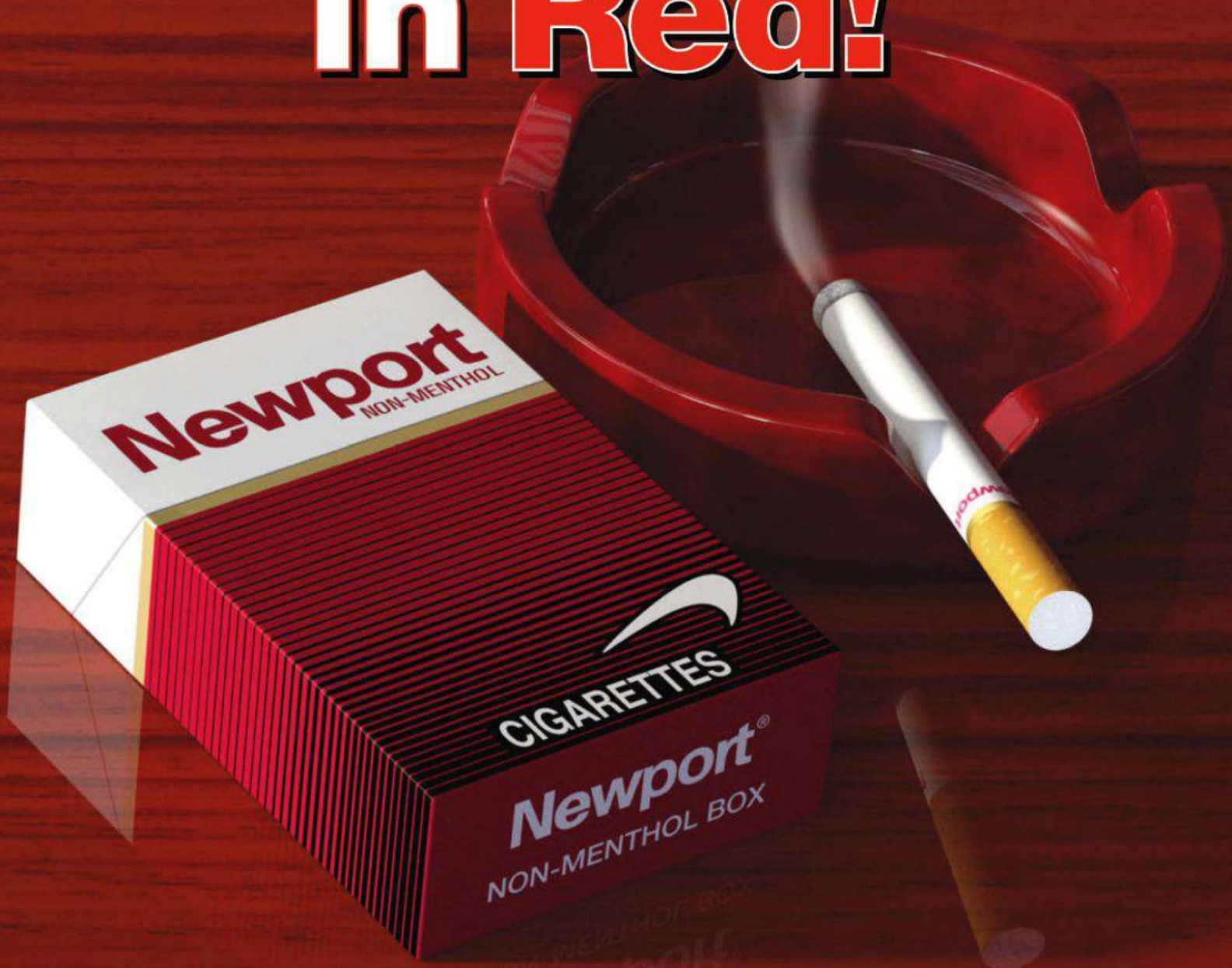
← A fully featured multimeter with a built-in infrared thermometer can easily run a couple of hundred dollars or more. The **Extech EX210 digital multimeter** (\$70) cuts the cost of the electrician's tool to a homeowner-friendly price point.

Polaroid Rage

When Polaroid announced it was ending production of its iconic instant film in 2008, the format's fans launched The Impossible Project, an online enterprise that reverse-engineered the old film in order to manufacture and sell new rolls. Well, maybe the company got the message after all. The new **Polaroid GL30 (price not set)** merges the classic instant-photography experience with a modern 12-megapixel digital camera. A built-in printer rolls out 3 x 4-inch pictures, while a memory-card slot and LCD screen allow the camera to be used for more than just popping out prints.



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Sun Light

↑ For millions of people living in electricity-deprived communities in developing countries, indoor light comes from kerosene—an antiquated and polluting fuel that presents a potentially serious health hazard. The **Nokero N200 Solar Light Bulb (\$20)** features a solar panel that absorbs power and uses it to illuminate four embedded LEDs for up to 6 hours. While the bulb is for sale in the U.S., its 13.5-lumen glow may appear underwhelming to those used to a 60-watt incandescent. Still, it should prove easy on the eyes—and lungs—of many, many people around the world.

Look, Ma, No Glasses!

Nintendo has done 3D before. Gaming historians (and not many others) might recall that in 1995, the company released an ill-fated system called the Virtual Boy—a bizarre goggle-based 3D console that was more nauseating (you know, from dizziness) than fun. With that lesson and presumably others behind it, the company is trying again with the **Nintendo 3DS (\$250)**. When we heard that this updated version of the mega-selling DS portable platform would deliver multidimensional images without glasses, we were skeptical of the hype. But then we saw—and believed. The 3D screen is like a window into another world, where planes fly above verdant landscapes and missiles jet out of sight. One drawback is that the screen has to be held at a specific angle to prevent blurring, so hyperkinetic gamers might need to work on holding their hands still. Others can just enjoy the view.



A Smarter Headset ← A Bluetooth headset can feel like a Get Out of Ticket Free card when you're behind the wheel. But if you have to dig the device out of a pocket or bag to answer a call, it can quickly morph from convenient to infuriating. The **Plantronics Voyager Pro UC headset (\$200)** detects whether it's on your ear, and routes calls to your phone if it's not.

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How to Start a Tablet Company Without Breaking a Sweat

The tech forecast for 2011 calls for tons of tablets. But for every blue-chip offering from Apple or Motorola, there are dozens of no-name slates from companies such as Cydle, Naxa and MiNew, most of which run Google's Android operating system. This got us to thinking: If so many companies can quickly move these products to market, how difficult could it be? We spoke to various component makers to find out exactly what it would take to get our own line of Android-powered tablets to market. Turns out it's not too hard to undercut Apple's iPad on price—as long as you're willing to skimp on some features. Here's the bottom line for producing el cheapo tablets (well, minus labor, marketing, distribution and requisite stadium-naming rights) in various configurations and with a standard 1000-unit minimum order. —GLENN DERENE

TOUCHSCREEN:
10-inch
capacitive

PROCESSOR:
800 MHz
EXTRA FEATURES:
Dual cameras,
HDMI output, 3G
antenna, GPS,
micro SD slot
OUR COST:
\$249/tablet
RETAIL PRICE
W/ 50% MARKUP:
\$373.50
STARTUP COST
FOR 1000 UNITS:
\$249,000
TOTAL REVENUE
FOR ORDER:
\$373,500
PROFIT:
\$124,500



TOUCHSCREEN:
7-inch
resistive

PROCESSOR:
600 MHz
EXTRA FEATURES:
None
OUR COST:
\$85/tablet
RETAIL PRICE
W/ 50% MARKUP:
\$127.50
STARTUP COST
FOR 1000 UNITS:
\$85,000
TOTAL REVENUE
FOR ORDER:
\$127,500
PROFIT:
\$42,500



HOW COOL IS THAT?

Microsoft Avatar Kinect

Until recently, the motion-tracking abilities on the Microsoft Kinect sensor bar have been limited to broad body movements. But it turns out the Xbox 360 peripheral is much more perceptive than first thought. With the new Avatar Kinect software update, the sensor now has the ability to track and mimic subtle changes in facial expressions. At first, the tech will be used to facilitate virtual "sets," where players' onscreen characters can gather and chat. While this may strike some as little more than a *Second Life*-like novelty, we can actually see it having some serious disruptive potential: University researchers could use the tech instead of spending thousands on other equipment (namely, the type they use now) that allows them to track minute changes in facial muscles in response to stimuli. It would be equally useful to Hollywood studios, which currently spend millions of dollars breathing life into CG characters. Of course, it raises the question: Are consumers ready for a TV that can tell when they are sad?



Microsoft's Avatar Kinect software can track and mimic subtle facial expressions.



Doomsday Clock

The feature list on the Eton Raptor (\$130) reads like a disaster-readiness checklist: LED flashlight, USB cellphone charger, digital clock, NOAA weather alert, AM/FM radio and (not least of all) bottle opener. Come to think of it, this puppy is like a digital, battery-powered Leatherman. A solar cell built into the back of the device means you'll never run out of power, and a rubberized, splash-proof shell comes in handy if your worst-case scenario involves a good drenching.



❖ **Gout's root cause is high uric acid.** If you have gout, high uric acid can lead to more attacks. To help reduce attacks, lower your uric acid.

ULORIC can help. ULORIC is clinically proven to help lower uric acid to a healthy level (less than 6 mg/dL).

Struggling with gout? Ask your doctor how ULORIC can help lower uric acid and bring gout's root cause down to a more manageable size.

Use of ULORIC

ULORIC is a prescription medicine used to lower blood uric acid levels in adults with gout. ULORIC is not for the treatment of high uric acid without a history of gout. Individual results may vary.

Important Safety Information

- Do not take ULORIC if you are taking Azathioprine, Mercaptopurine, or Theophylline.
- Your gout may flare up when you start taking ULORIC; do not stop taking your ULORIC even if you have a flare. Your healthcare provider may give you other medicines to help prevent your gout flares.
- A small number of heart attacks, strokes, and heart-related deaths were seen in clinical studies. It is not certain that ULORIC caused these events.
- Tell your healthcare professional about liver or kidney problems or a history of heart disease or stroke.

- Your healthcare professional may do blood tests to check your liver function while you are taking ULORIC.
- The most common side effects of ULORIC are liver problems, nausea, gout flares, joint pain, and rash.

Please see accompanying Important Patient Information for ULORIC on adjacent page and talk to your healthcare professional.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.

For more information, visit www.ULORIC.com or call 1-877-ULORIC-6.



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Uloric
(febuxostat) tablets

PATIENT INFORMATION

ULORIC® (Ū-'lor-ik) (febuxostat) tablets

Uloric
(febuxostat) 40mg/80mg
tablets

Read the Patient Information that comes with ULORIC before you start taking it and each time you get a refill. There may be new information. This information does not take the place of talking with your healthcare provider about your medical condition or your treatment.

WHAT IS ULORIC?

ULORIC is a prescription medicine called a xanthine oxidase (XO) inhibitor, used to lower blood uric acid levels in adults with gout.

It is not known if ULORIC is safe and effective in children under 18 years of age.

WHO SHOULD NOT TAKE ULORIC?

Do not take ULORIC if you:

- take Azathioprine (Azasan®, Imuran®)
- take Mercaptopurine (Purinethol®)
- take Theophylline (Theo-24®, Elixophyllin®, Theochron®, Theolair®, Uniphyll®)

It is not known if ULORIC is safe and effective in children under 18 years of age.

WHAT SHOULD I TELL MY HEALTHCARE PROVIDER BEFORE TAKING ULORIC?

Before taking ULORIC tell your healthcare provider about all of your medical conditions, including if you:

- have liver or kidney problems
- have a history of heart disease or stroke
- are pregnant or plan to become pregnant. It is not known if ULORIC will harm your unborn baby. Talk with your healthcare provider if you are pregnant or plan to become pregnant.
- are breast-feeding or plan to breast-feed. It is not known if ULORIC passes into your breast milk. You and your healthcare provider should decide if you should take ULORIC while breast-feeding.

Tell your healthcare provider about all the medicines you take, including prescription and non-prescription medicines, vitamins, and herbal supplements. ULORIC may affect the way other medicines work, and other medicines may affect how ULORIC works.

Know the medicines you take. Keep a list of them and show it to your healthcare provider and pharmacist when you get a new medicine.

HOW SHOULD I TAKE ULORIC?

- Take ULORIC exactly as your healthcare provider tells you to take it.
- ULORIC can be taken with or without food.
- ULORIC can be taken with antacids.
- Your gout may flare up when you start taking ULORIC, do not stop taking your ULORIC even if you have a flare. Your healthcare provider may give you other medicines to help prevent your gout flares.
- Your healthcare provider may do certain tests while you take ULORIC.

WHAT ARE THE POSSIBLE SIDE EFFECTS OF ULORIC?

Heart problems. A small number of heart attacks, strokes and heart-related deaths were seen in clinical studies. It is not certain that ULORIC caused these events.

The most common side effects of ULORIC include:

- liver problems
- nausea
- gout flares
- joint pain
- rash

Tell your healthcare provider if you have any side effect that bothers you or that does not go away. These are not all of the possible side effects of ULORIC. For more information, ask your healthcare provider or pharmacist.

Call your doctor for medical advice about side effects. You may report side effects to the FDA at 1-800-FDA-1088.

HOW SHOULD I STORE ULORIC?

Store ULORIC between 59°F - 86°F (15°C - 30°C).

Keep ULORIC out of the light.

Keep ULORIC and all medicines out of the reach of children.

GENERAL INFORMATION ABOUT THE SAFE AND EFFECTIVE USE OF ULORIC.

Medicines are sometimes prescribed for purposes other than those listed in a patient information leaflet. Do not use ULORIC for a condition for which it was not prescribed. Do not give ULORIC to other people, even if they have the same symptoms that you have. It may harm them.

This patient information leaflet summarizes the most important information about ULORIC. If you would like more information about ULORIC talk with your healthcare provider. You can ask your healthcare provider or pharmacist for information about ULORIC that is written for health professionals. For more information go to www.uloric.com, or call 1-877-825-3327.

WHAT ARE THE INGREDIENTS IN ULORIC?

Active Ingredient: febuxostat

Inactive ingredients include: lactose monohydrate, micro-crystalline cellulose, hydroxypropyl cellulose, sodium croscarmellose, silicon dioxide, magnesium stearate, and Opadry II, green



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Two Lenses, 3D → Most consumer 3D camcorders sacrifice resolution in order to pull off their multidimensional trickery. The **Sony HDR-TD10 3D Handycam (\$1500)** uses two HD lenses, both working at full 1080p resolution, to produce what Sony claims is the “first true HD” consumer 3D camera. And the 3.5-inch playback LCD screen? It’s one of a growing number found on consumer devices that can show 3D footage sans glasses.



M Milwaukee's Beast

Milwaukee calls its new lithium-ion **M12 Hammer Drill Driver (\$100)** the “industry’s first sub-compact hammer drill driver.” Sounds like the marketing department is grasping at semantic straws, but the claim is actually on the mark. No bigger than a screw gun (seriously, this thing weighs less than 3 pounds and is just shy of 8 inches long), the M12 delivers 275 inch-pounds of concrete-pounding torque—an impressive power-to-size ratio if ever we’ve seen one.



Dock Worker

↓ If it were just a phone, the **Motorola Atrix 4G (price not set)** would be one of the most powerful ever, what with its 1-GHz dual-core processor and a full gig of RAM. But thanks to an ingenious accessory ecosystem, it is so much more. Place the phone in a laptop-like docking station and it serves as the brains for a full-fledged PC, shaving pounds off a road warrior’s gear. Connect the phone to a high-definition multimedia dock and it transforms your TV into an Internet-connected set. And how’s this for a magic trick: As soon as the phone is docked, it automatically scales up its resolution to fill either display.



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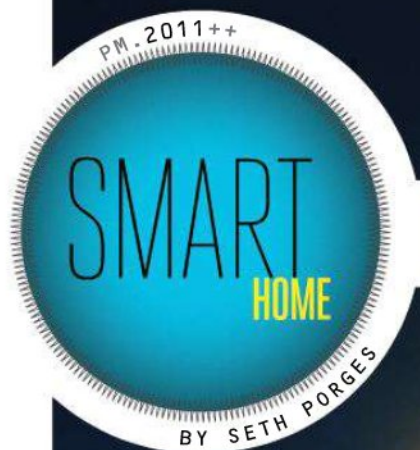
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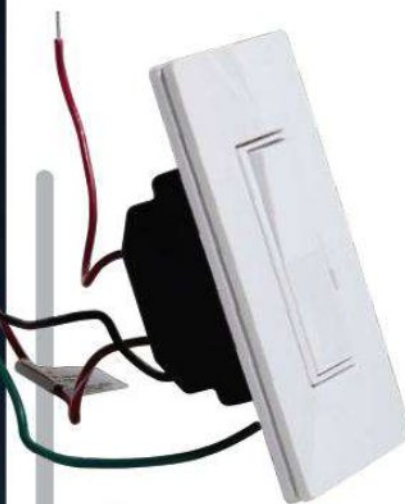


UPGRADE

THESE NEW PRODUCTS CAN CUT YOUR HOME'S FOOTPRINT—AND ENERGY BILL.

Way to Glow

More than 130 years after Thomas Edison first cobbled together a commercially viable light bulb, the U.S. is poised to switch off sales of the classic incandescent, with a multiphase ban starting in 2012. And while relatively efficient compact fluorescent light bulbs (CFLs) have been around for years, the future may lie with light-emitting diodes (LEDs). They use less energy and last longer than CFLs, and they're made without mercury, a toxin. For our money—and quite a bit of it—the **Philips AmbientLED Lamp (\$40)** is a worthy LED stand-in for a 60-watt incandescent. Most LEDs cast a directional beam, but the AmbientLED has 360-degree illumination, and its yellow enclosure lends an incandescent-like tone. The bulb uses just 12 watts, offsetting some of its high price with energy savings.



↑ Dim and Dimmer

Dimmers don't just produce good mood lighting—they're also an easy way to dial down the energy a light bulb uses. Unfortunately, the controls can be skittish when it comes to CFLs, which frequently suffer from a reduced dimming range and dropouts, among other annoyances. The **Lutron Diva C-L Dimmer (\$40)** appears to have worked out the kinks—it reliably controls just about any bulb, including CFLs.



↑ A Greener Lawn

Two-stroke, gas-powered yard tools are notorious polluters. But during the past year, we got our hands on battery-powered models with enough juice to handle our yard, such as the **Black & Decker 20V Max Lithium-Ion (\$130)** and **Craftsman C3 19.2V (\$110)** electric string trimmers. They're part of an emerging category of tools leading the way to clean, efficient and quiet grounds-keeping. That's good for you—and your neighbors.

STUDIO D (LIGHT BULB); ANJA HITZENBERGER (DIMMER)

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Introducing the new HTC EVO Shift 4G. It's 4G fast and powered by Android™, just like the EVO. But the Shift is smaller and has a slide-out keyboard to go along with its touchscreen. Now you can touch or type at the speed of 4G. Only from Sprint. The Now Network.™

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SMART HOME

PM 2011++



↑ Wireless Fridge

The Wi-Fi-enabled touchscreen on the **Samsung RF4289 Refrigerator (\$3500)** does more than just display recipes and Twitter feeds—it also tells users exactly what temperatures the appliance is keeping at any given time, allowing for easy adjustments if things aren't right.

UPGRADE



↑ An Automatic Off Switch

Few people bother to shut off all their home-theater gear when they aren't watching TV, an obvious waste of energy. The **Belkin Conserve Smart AV Surge Protector (\$30)** detects when a TV is turned off and automatically cuts power to as many as five connected devices—such as DVD players, sound systems and gaming consoles—while keeping a constant flow of juice to ones that always need it, like a wireless router or DVR.

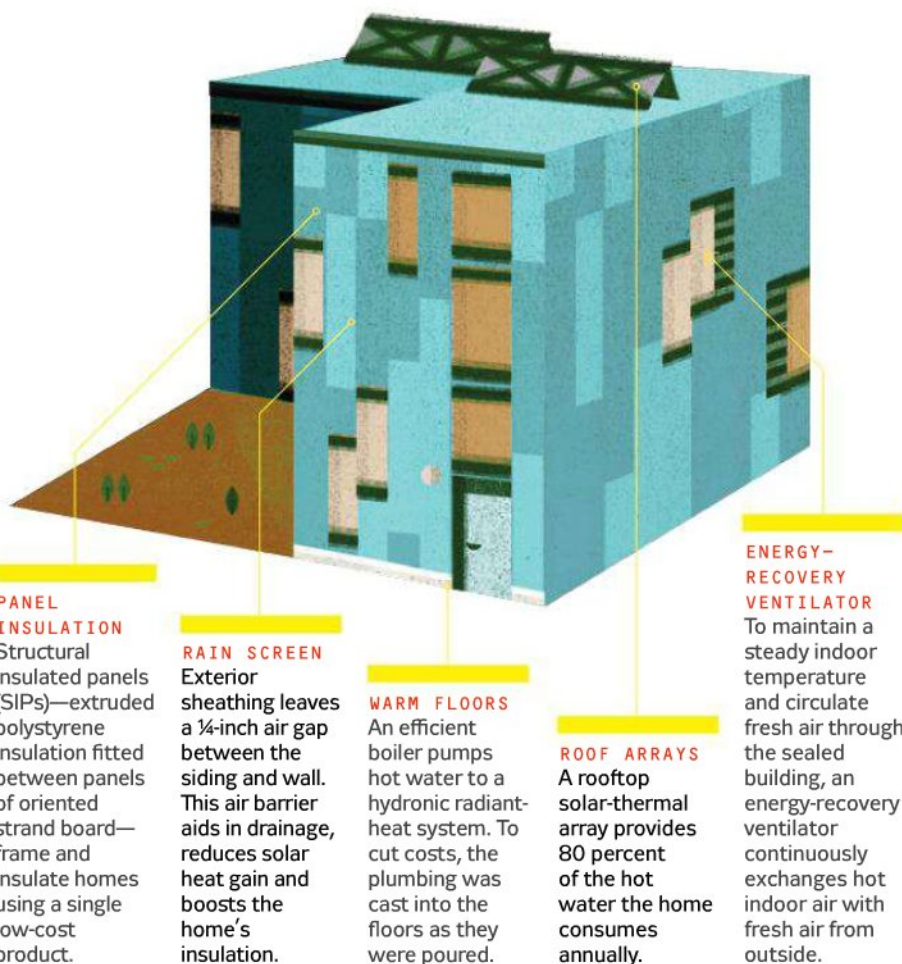


← This Range Has Range

"Flexible" isn't a word often used to describe an oven. Because most ranges feature one big baking compartment, they eat up the same amount of power while heating up a dish, be it large or small. An excellent example of the new breed of smart stoves, the **LG LDE3017ST Range (\$2200)** has separate doors that open to two smaller-scale sections (a 4.4-cubic-foot oven on the bottom and a 2.3-cubic-foot infrared-heated broiler on top). The design allows you to choose the right box for the job and use only as much energy as necessary. Having two cooking compartments also makes it easier for culinary multitaskers to juggle multiple dishes at once.

The \$100,000 Smart Home

In a perfect world, energy-efficient architecture would save homeowners money—not cost a premium. This is why we're excited about the Philadelphia 100K House, selected by the U.S. Green Building Council as its 2010 House of the Year. The dwelling can be built for about \$100,000 in labor costs and materials, including no-frills concrete and exposed plywood finishes. The architects, Interface Studio, collaborated with design/build firm Postgreen to reproduce key elements from their award-winning structure in almost a dozen Philly houses now for sale, starting at about \$250,000. The pilot house's total utility bills cost \$900 per year, and some of the newer models can cut that figure in half. Here are some energy-saving features from the 100K House we'd like to see other developers adopt. —HARRY SAWYERS



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AUDI A6

CHEVROLET
SONIC

FORD
VERTREK

HONDA CIVIC

HYUNDAI
VELOSTER

KIA KV7

PORSCHE
918 RSR

PRIUS C

VW PASSAT

FORD VERTREK

The box on wheels that is the Ford Escape will soon look much like the Vertrek concept. Those smooth corners will not reduce interior space, Ford says, thanks to a nearly 4 inches longer body. Expect a 1.6-liter EcoBoost four-cylinder as the base engine.

Motown Reborn

BY LARRY WEBSTER

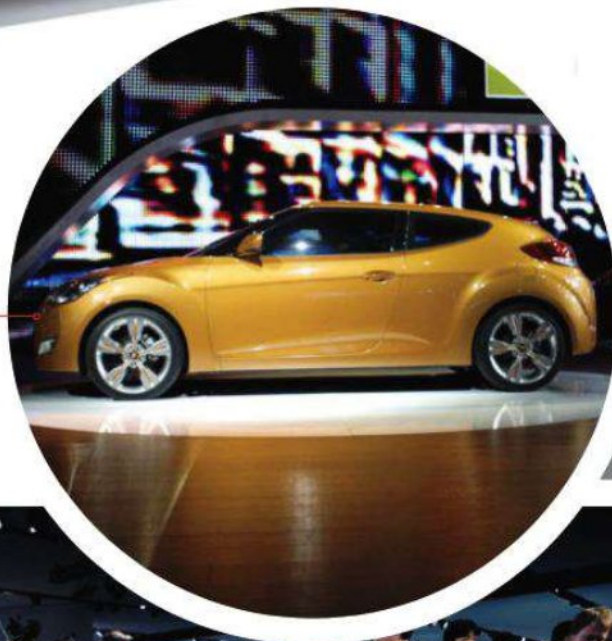
By usual standards, this year's Detroit Auto Show should have been a snoozer: There weren't a lot of exciting new models or breakthrough concepts on display. Yet the general mood was far brighter than the doomsday aura of '09 and '10. Big Three executives, buoyed by 2010 sales figures that were up 10 percent, profits (Ford cleared \$6.6 billion last year) and the momentum of award-winning cars (the Chevy Volt and Ford Explorer took car and truck of the year honors), could be seen skipping and humming across the show floor. The industry has slashed costs and is poised to reap massive profits as buyers slowly return to showrooms. We heard the usual hyperbolic pronouncements of higher sales, increased market share and general world domination from every manufacturer. Having finished licking their wounds, carmakers are looking for this year to solidify the recovery. Here's a snapshot of Detroit's hottest concept- and production-car reveals.

DETROIT
AUTO
SHOW
2011



PORSCHE 918 RSR

At 6:30 am on the first day, the show started with a bang—you could nearly hear chins hitting the floor—when Porsche unveiled the undeniable star of the event. The hybrid racer features a midmounted 563-hp V8, electric motors on the front wheels, and a flywheel energy-storage unit that can send a huge 8-second boost of power to those motors on command. Expect to see this racing lab plying road courses this summer.



HYUNDAI VELOSTER

Coming this summer, the Veloster signals the return of affordable and sporty coupes. The roughly \$17,000 Veloster features three doors—two on the passenger side—to ease ingress to the surprisingly roomy rear seat. Initially, a 138-hp four-cylinder will power the front wheels, but we hear a turbo version isn't far behind. Also, Hyundai will offer a dual-clutch gearbox, and it promises 40 mpg.

CHEVROLET SONIC

Like Ford, Chevy is now taking small cars seriously, and it will replace the hopelessly flawed Aveo with the Sonic. Corvette engineers have supposedly tweaked the suspension for sharp dynamics, and a turbo engine with a six-speed manual could make this the most appealing small car in GM's history. Maybe it'll make us forget the Vega.



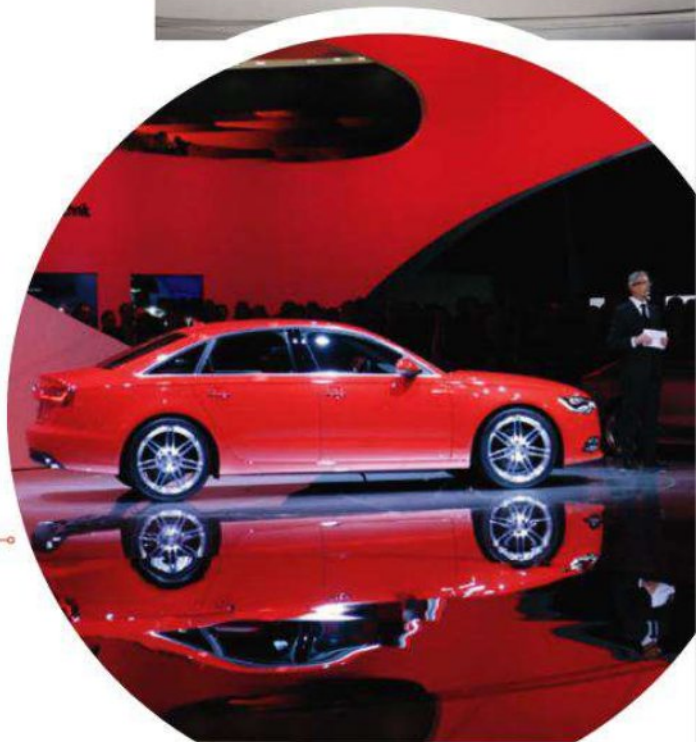


AUDI A6

It's becoming increasingly clear that the best-looking sedans aren't from Italy; they're from Ingolstadt, Germany, where Audi four-doors emerge with a street presence few match. The new A6 arrives this spring shed of nearly 200 pounds—thanks to higher aluminum content—and with a 295-hp supercharged V6. A hybrid model is due next year, with a reported 38 highway mpg.

HONDA CIVIC

The Civic was the sixth-best-selling car last year, an impressive record for a car that hasn't changed since 2006. So, naturally, the new version, which is due this summer, does not deviate greatly from the current car. As before, coupe, sedan and hybrid models will flesh out the lineup. But Honda promises wider availability of the natural-gas-powered version.



PRIUS C

This year, the Prius will spawn hybrid offspring, becoming a brand, just like Lexus and Scion. The Prius c is a small hybrid hatchback that promises entertaining driving dynamics and frugal fuel use, a claim we've heard before but have yet to see executed well (we're talking to you, Honda CR-Z). The c will arrive next year.



VW PASSAT

We've known for at least a year that VW would build a new midsize sedan to compete, price- and sizewise, with sedans like the Toyota Camry and Honda Accord. Now we know that the new car will replace the Passat, it's as roomy as an Accord, and it will start at about \$20,000. But only VW will offer a diesel engine.

KIA KV7

Sprucing up the minivan seems an evergreen concept-car theme. Kia's KV7 people-hauler embraces squared corners and envisions wide-opening gullwing doors and a luxurious wood floor. This would make a fine complement to Kia's funky Soul small SUV, but presently the KV7 is just an idea.



2011 Chrysler
300

Slick Sedan

With a choice of a modern, flexible V6 or a famously brawny V8, Chrysler's new 300 seeks to pick up where its award-winning forebear left off. Now flaunting crisp creases in its cubist shape, and modeling an upscale grille between jeweled headlights, the 300 has the look of an athlete in a sharp suit rather than that of a nightclub bouncer. We drove the cars near the Mexican border in San Diego County, and even the border guards waved us on with upturned thumbs. Chrysler has quieted the cabin and refined the suspension action to great effect. The company has also beefed up the structure, added the latest driver aids (such as collision warning, blind-spot monitoring and an AWD option) and slathered the interior with upscale materials and textures. It's now a car that feels like it belongs in the premium class, yet the V6 300 starts at \$27,995. Which is, as Chrysler personnel are happy to point out, less than Toyota's Avalon. — **BARRY WINFIELD**

QUICK CHARGER

Ford's electrified Focus swaps the gas engine for a 123-hp electric motor and carries a liquid-cooled 23-kwh Li-ion battery pack under the floor and rear seats. The range should be about 100 miles. In other words, it will perform a

lot like Nissan's Leaf. Ford, however, claims the Focus can be recharged in only 3 hours. Granted, that figure assumes a 240-volt Level 2 charger, but even with the higher voltage, the Leaf requires about double that time. With only 120 volts, the Focus needs a painful

16 to 20 hours for a full charge, which makes the navigation system's charge-station finder a critical feature. We'll have to wait about a year to test that 3-hour claim, but if it's true, the Focus EV will be a huge step toward making EVs more usable. — **BEN WOJDYLA**

Ford has partnered with Best Buy to sell and install 240-volt chargers.



SILENT DELIVERY

Ford's first credible EV, an **electrified version of the Transit Connect van**, is on sale now, although only about 200 will be produced this year. Thanks to an under-the-floor lithium-ion battery pack (28 kwh), the cargo hauler doesn't lose any interior space, but the extra half-ton of weight reduces payload to 1000 pounds. The electric motor's paltry 78-hp maximum output is offset by near-instantaneous torque (117 lb-ft), so it doesn't feel slug-bug slow. While it's meant mainly for utility-company fleets, eco-minded suburbanites can buy a TC EV with rear seats. But they'll have to endure a \$57,400 price, before incentives. — **BEN WOJDYLA**

2012 Ford
Focus EV



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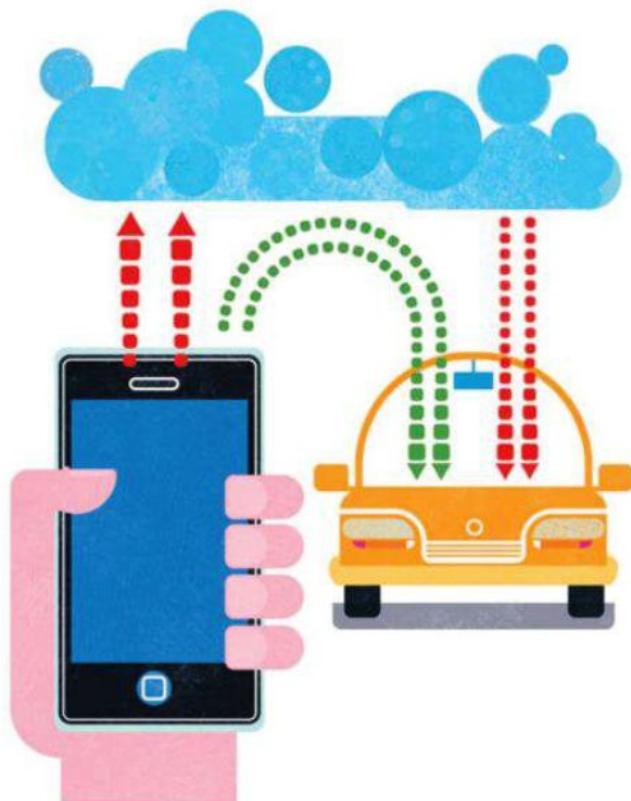
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Apps Hit the Road

Car electronics evolve quicker than new vehicles can be engineered, so automakers are turning to apps to continually add new features. *BY LARRY WEBSTER*



In-vehicle entertainment and information systems—collectively known as infotainment—are quickly becoming as important to buyers as what's under the hood. Last year, 80 percent of new Fords had some version of Sync, and other automakers are rushing to meet the demand. But there's a problem: When it comes to gadgets, we're conditioned to expect hyper-evolution, not the years it takes to engineer a new car. So automakers are now turning to app-based platforms—much like the ones on smartphones—to provide a continual feed of new features. Carmakers, however, are reluctant to open the doors to an uncharted flood of third-party developers. "We want to retain the customer experience we've worked to establish," says Stephan Durach, the director of BMW's Palo Alto research lab. That means the apps, which either live on a smartphone, in the car or in the cloud, will use the interface already in the car's dash. Or, as in the case of Ford's AppLink, voice commands, which will be a required feature to minimize driver distraction. That's an issue that will remain hot. So, no Doodle Jump—at least for now.

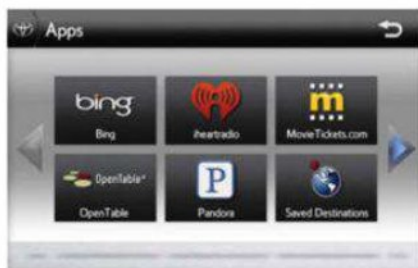
In any case, we're in the early stage, and the available apps are already-familiar ones like Pandora and Twitter. That could change quickly. Ford says it is currently reviewing 1000 third-party submissions. GM recently announced a contest for college students to submit ideas that may one day lead to unforeseen capabilities. In the meantime, here's a sampling of what's coming or is already here.



MINI CONNECTED ➤ Car-specific apps live on an iPhone but are displayed on the car's screen and controlled by the dash knobs. The currently available apps (Pandora, Twitter, Web radio, a driving-efficiency coach and others) are available for free in Apple's iTunes Store. Will soon work with non-Apple phones.

Best Feature ➤ The Twitter app reads the car's internal data and offers canned status updates like "Heading to Chicago. It's 72 degrees, the top is down and life is great!"

Availability ➤ Currently on Minis equipped with the navigation system, and will soon join BMW's lineup.



TOYOTA ENTUNE ➤ With Entune, your Bluetooth-enabled phone is a gateway to car-specific apps that live in the cloud. The apps are displayed on the navigation screen and offer some voice-controlled features like Bing search. Presently, apps include OpenTable and Pandora, but will expand. One downside: The service will eventually come with a not-yet-specified fee.

Best Feature ➤ The Pandora mobile app uses the same familiar screen and functions as it does on your computer.

Availability ➤ Coming this summer in the Prius v (a wagon version of the Prius) and in more cars later this year.



FORD APPLINK ➤ In conjunction with Ford's Sync system, the apps live on a variety of phones and connect to the car with either Bluetooth or a USB cable. Bonus: AppLink does not require the car to have a pricey factory navigation system, and Ford's already relying heavily on voice commands.

Best Feature ➤ For Pandora, say "thumbs up" when you like a song.

Availability ➤ In the Ford Fiesta with the \$395 optional Sync, and in the Ford Mustang later this year.

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It's not just for pregnant women. It's not just for old people... It is Sciatica and millions of Americans suffer lower back and upper leg pain from it. You can usually diagnose the condition yourself:

The Pain of Sciatica

- ✓ An attack usually starts with a dull ache in your lower back.
- ✓ Soon the pain spreads to your buttocks and into the back of your thighs.
- ✓ The intensity of the pain increases, and it changes from a dull ache to a searing, burning sensation.

It seems to strike just before you have something important planned, such as travelling on a plane or train, an activity requiring hours of sitting or bending.

That's why there's no GOOD time for a BAD back. So, let's examine what might be happening to many of you. Let's look at your back.



Lumbar disk compression

Sciatica assaults the lumbar disk area of your spine. That is the area at the bottom of your spinal column. A slight hernia in the disk compresses the sciatic nerve. Until now, the most common treatment is restricted movement and warm compresses. Yes, good old *rest and heat*! But there is a new answer!

SciatiCalm™ alleviates the symptoms of Sciatica from the inside-out!

It may be hard to believe, but **SciatiCalm** can reduce, even eliminate sciatic pain faster!

How? Simple.

SciatiCalm works as a homeopathic medicine that literally goes to the "root" cause of your pain!

As you have read, pain is caused by the compression of the sciatic nerve root. SciatiCalm tablets are specially formulated to speed directly to that area, working quickly and effectively to reduce the compression of the nerve.

SciatiCalm works on the subdermal pain receptors to reduce the pain and numbness, and you only take it as you need.

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SciatiCalm gives you fast relief from acute sciatic pain attacks, plus it helps with long-term reduction in the frequency and severity of your attacks.

The SciatiCalm System breakthrough gets you back into the swing of things to enjoy the active lifestyle that is such an important part of a healthy life.

What makes SciatiCalm so unique, so powerful and so effective?

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- Camomilla: Reduces those tearing and pulling pains in your lower back.
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- Gnapphalium: Reduces the pain transmitted by the sciatic nerve.

perform normal tasks returns faster than you thought possible. If you want to feel good again, without the searing, numbing pain of a sore lower back and upper thighs, you need to try SciatiCalm.

With SciatiCalm you will...

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Yes, your satisfaction is 100% **GUARANTEED.*** If you are not completely satisfied with the results you see within the first 30 days of using the SciatiCalm System, just return any unused portion for a complete refund of the product price.

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Be one of the first 500 callers **NOW** to participate in our **RISK-FREE** trial* of SciatiCalm.

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Mean, Green Big-Buck Machines

Recently, many manufacturers have unveiled expensive alternative-fuel supercars. Some are real and some are just concepts. Where'd they all come from? **BY SAM SMITH**

It used to be that the car industry ran by certain rules. Small cars didn't use a lot of gas; big ones did. Slow cars were clean and green; fast ones, dirty and mean. No more.

Recently, a handful of carmakers have revealed expensive hybrid or electric supercar concepts. These machines vary in construction and design, but all of them sip fuel rather than slurp it. Why the sudden rush of planet-friendly performance? First, green cars like the Tesla roadster are hip, and the super-rich are nothing if not trend watchers. (Few things elicit boardroom sneers like last year's Ferrari.) But more important, these cars serve as rolling science experiments and sexy PR stunts that gauge public reaction. Most will never see a showroom, but for now, only one thing matters: They exist.



MERCEDES-BENZ SLS AMG E-CELL ▶ Past, meet the future. The SLS AMG E-Cell is a much modified, battery-powered version of Mercedes' retro-styled SLS supercar. A low-drag version of the SLS's body and four electric motors (one at each wheel) are standard. The E-Cell is 800 pounds heavier than its 3800-pound gasoline-powered sister, but when it goes on sale in 2012, it should hit 160 mph.

POWERTRAIN ▶ Four electric motors, 48-kwh lithium-ion battery pack

OUTPUT ▶ 526 hp, 649 lb-ft

0-60 MPH ▶ 4.0 seconds

PRODUCTION? ▶ 2012



BMW VISION EFFICIENT DYNAMICS ▶ The Vision is a plug-in diesel hybrid concept that owes its proportions to BMW's legendary 1970s M1; when it reaches production in 2013, it won't look quite this outlandish, but it will feature a turbocharged engine and four-wheel drive. Expect it to be offered in two forms—a 300-hp three- or four-cylinder "efficiency" model and a 450-hp six-cylinder speed demon.

POWERTRAIN ▶ 1.5-liter, 163-hp turbodiesel I-3; 139-hp electric motor; 51-hp electric motor; 10.8-kwh lithium-ion battery pack

OUTPUT ▶ 353 hp, 590 lb-ft

0-60 MPH ▶ 4.7 seconds

PRODUCTION? ▶ 2013



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One Tough Animal™



AUDI E-TRON SPYDER ▶ Audi has been batting the e-tron concept name around for years; the hybrid Spyder is the latest car to carry the moniker. Awesome looks and a grunty diesel V6 are paired with two front-mounted electric motors. The production e-tron, due in 2012, is likely to be larger and based on Audi's R8.

POWERTRAIN ▶ 3.0-liter, 300-hp turbodiesel V6; two 44-hp electric motors; 9.1-kwh lithium-ion battery pack

OUTPUT ▶ 388 hp, 739 lb-ft

0-60 MPH ▶ 4.3 seconds

PRODUCTION? ▶ 2012, but it probably won't look like this or be a roadster.

JAGUAR C-X75 ▶ Chalk this one up as a flight of fancy. Jaguar's sexy C-X75 is a fiberglass-bodied, aluminum-framed, plug-in hybrid dreamboat boasting a hefty battery pack and two micro gas turbines. Sadly, it's just a research project—you'll never see one on the street.

POWERTRAIN ▶ Two 94-hp gas turbines, four 195-hp electric motors, 19.6-kwh lithium-ion battery pack

OUTPUT ▶ 780 hp, 1180 lb-ft

0-60 MPH ▶ 3.3 seconds

PRODUCTION? ▶ When electric pigs fly.



PORSCHE 918 SPYDER

This might be the coolest green supercar of them all. The 3285-pound 918—the name is a callback to Porsche's all-conquering 917 endurance racer—is a parallel hybrid powered by a small gasoline V8 and a pair of electric motors, one at each axle. Exact figures haven't been released, but look for 700-plus combined horsepower and a \$600,000-plus price tag.

POWERTRAIN ▶ 3.4-liter, 500-hp V8 (est.); two 109-hp electric motors; lithium-ion battery pack

OUTPUT ▶ 718 hp (est.)

0-60 MPH ▶ 3.1 seconds

PRODUCTION? ▶ 2014



FERRARI 599 GTB HY-KERS CONCEPT

This is Ferrari's preview of future hybrid powertrains; it can run solely on electric power at low speeds. It's little more than an "ordinary" 599 GTB—Maranello's top-of-the-line GT—with a twin-clutch transmission mated to a 107-hp electric motor. Think of it as the sexiest, fastest Prius you can't buy.

POWERTRAIN ▶ 6.0-liter, 611-hp V12; 107-hp electric motor; 3-kwh lithium-ion battery pack

OUTPUT ▶ 718 hp, 559 lb-ft

0-60 MPH ▶ 3.5 seconds

PRODUCTION? ▶ No, but expect the technology in Ferrari showrooms within the next five years.

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Almost the Future

> BY JAY LENO

> PHOTOGRAPHS BY JOHN LAMM



Today, electric motors challenge piston-engine dominance, but back in 1963, Chrysler had another idea—a turbine-powered car.

T

HE 1964 NEW YORK WORLD'S FAIR featured a very special car, the Chrysler Turbine. I made the trip from Massachusetts with my parents just to see it. At the fair, there was a long line of people around the block, waiting for a ride. The gas turbine engine made a jet-like *wooooooshhhh* noise as the car went around and around in a little circle. But I didn't get a ride. My dad said, "We're not waitin' in line all day just to ride in a goddamn cah." I've always remembered that.

Just 55 Turbines were built. Chrysler held on to five for evaluation and made 50 available for testing by 203 families nationwide who were chosen from 30,000 volunteers. Each family kept the car for three months. As part of the deal, the drivers recorded impressions and mileage in little logbooks. Chrysler had a special team of mechanics on call who flew out and fixed the cars right away if anything went wrong.

The families who tested the Turbines were treated like rock stars in their towns. It was a time when kids went crazy for cars; I still meet guys who remember where they were when they saw a Turbine go by. The test program lasted 27 months, and everybody who tried the Turbine liked it.

The car was the brainchild of chief engineer George Huebner, who began studying the feasibility of turbine-powered vehicles in the mid-1940s. The engine's smoothness and durability seemed to be a viable alternative to the piston engine. It has few moving parts—just fan blades on a shaft separated by a combustion chamber—one spark plug and no cooling system. A compressor at the inlet pressurizes incoming air, which



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JAY LENO'S GARAGE/// CHRYSLER TURBINE CAR

then combines with fuel and ignites. The expanding charge spins the turbine section that is geared to the output shaft. The car was rated at 130 hp and 425 lb-ft of torque at stall speed, about the same as a contemporary 318-cubic-inch V8.

Huebner built a few ordinary-looking prototypes in the '50s, but the pilot-program cars would be driven—and seen—by the public, so Elwood P. Engel crafted an all-new, futuristic body. Before joining Chrysler in 1961, Engel had worked at Ford, where he designed the 1958 Thunderbird; hence the Turbine's resemblance. The unit bodies were hand-built by Carrozzeria Ghia in Turin, Italy, and shipped to Detroit for final assembly.

In 2008 I finally got a chance to drive one, when I bought mine from the Chrysler Museum. It's one of only three that are still operational. Most were destroyed by Chrysler for tax and liability reasons, which is a shame, because to this day everyone who rides in a Turbine says, "Whoa, this feels like the future!"

You turn the key and there's a big *woosh* and a complete absence of vibration. Put it in drive, and you just press the gas pedal and go. It's like taking a '60s-era Buick Electra or Cadillac up to 60 mph, then putting it in neutral and coasting. There's a tachometer, but you're idling at 22,000 rpm! It's reasonably quick, but not a rocket, and the engine is so well-integrated that anyone can drive it.

One aspect of the car that really hurt it back in 1963 was that drivers couldn't use the most widely available fuel: leaded gas. Tetraethyl lead eroded the turbine fins. Nobody cared about alternative fuels when gasoline was 27 cents a gallon, so the diesel fuel that the Turbine required wasn't easy to find. You had to go to a truck stop or drive around to the back of a gas station to the diesel pump, and it was smelly No. 2 diesel—the same as heating oil—not the nice, clean diesel we get today. Back then, drivers didn't



Above: The turbine was rated at 130 hp and 425 lb-ft, and routed power to a standard TorqueFlite automatic. Left: Finned cylinders are not for the exhaust—spent gases exit under the car—they're jet-age taillights.

like diesel fuel because it was dirty and messy, and the pump handle was always greasy.

With a few simple adjustments, the Chrysler Turbine actually runs on nearly any fuel. In France, the tank was filled with Chanel No. 5. In Mexico, at the request of the president, it was run on tequila. The Turbine was demonstrated all over the world, and people wondered, "Wow! What's America going to do next?" It was a really inventive time, when the best stuff came from the U.S.

Of course, there were a lot of myths associated with the Turbine. Years later, one automotive editor wrote, "Other than setting the grass on fire and melting the asphalt, they were great cars." I called him on it, and he admitted, "I just assumed a lot of heat was coming out the back."

I said, "No, the whole genius about the Chrysler Turbine was they invented a regeneration feature that made the exhaust cooler than a piston engine's." The engine temperature is 1400 degrees, but two spinning regenerators force hot exhaust gases into

the incoming airstream. Using regeneration kept the exhaust temperature down to 140 degrees.

The high cost was one reason the Turbine never made it into series production. Back then you could buy a V8-powered car for \$5000, or this jet-engine car that would have cost around \$16,000. They had about equal performance, and the Turbine car wasn't especially efficient. On the highway, you got about 19 mpg, which wasn't bad. But in town, idling at 22,000 rpm, it used a lot of fuel. So, given the choice, most people would have said, "I'll take the V8."

Between 1949 and 1981, Chrysler built seven different generations of turbine test vehicles. The company's shaky finances, the challenge of reducing the engine's NO_x output, the oil embargo and the need to downsize cars for front-wheel drive all hurt the Turbine's chances. I think it's the most collectible American car—it was so different. Most of all, the Chrysler Turbine is a reminder that all the cool stuff used to be made in the U.S. I hope it will be again. **PM**




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UNDERCOVER INVESTIGATIONS HAVE MOVED ONLINE IN THE CAT-AND-MOUSE GAME BETWEEN POLICE AND CRIMINALS.

ABOUT THREE TIMES A week, Susan James, a 37-year-old blond prosecutor from the Midwest, signs on to Facebook as Nakesha*, an attractive 26-year-old with a dark ponytail and sunglasses that conceal her eyes.

James created Nakesha's profile from a photo she found through Google. Her favorite TV shows?

Keeping Up With the Kardashians and *For the Love of Ray J*. Her favorite quote? "What doesn't kill me makes me stronger." She even has a fake birthday, on which her Facebook friends sent her greetings like, "Yo, happy birthday, mama."

When Nakesha is online, James is undercover. She structured the profile as bait for local criminals, whom she chats up to get a glimpse into their operations. Nakesha now counts drug dealers, gang members and their girlfriends among her 76 friends.

"Nakesha has more friends than I do on my own account," James says.

But both women are primarily interested in one man—a drug kingpin James has been investigating for several years. He's been arrested more than a dozen times but has never gone to jail—in part because he's careful. He changes cellphones, SIM cards and cars as often as most people change their socks.

On one occasion, James used her Facebook presence to help facilitate

**Names have been changed, as this is an active investigation.*

The Antisocial Network

> BY CAREN CHESLER
> ILLUSTRATION BY ALEXANDER WELLS



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POLICE TECH/// ANTISOCIAL NETWORK

wiretapping a phone registered to one of the kingpin's associates. Drug dealers often register phones to bogus names like Mickey Mouse. But when James, through Facebook, asked the associate what his plans were one night, he responded through an app he had downloaded to his iPhone. Her office quickly tracked the purchase to identify the number.

Like almost every other aspect of modern life, street crime is now deeply intertwined with digital technology. And social networks in particular have become part of the organizing structure of criminal networks—from street gangs to anarchist agitators.

To infiltrate these networks, law enforcement officials in both small police departments and large government agencies spend an increasing amount of time looking for criminals on social media websites such as Facebook, Myspace and Twitter. While they used to go undercover on the street, cops now gather intel online, mining suspects' profiles for photos, accomplices and potential evidence.

"Criminals leave footprints everywhere they go—on their cellphones, on their Twitter accounts and on Facebook," says Lauri Stevens, a principal strategist at LAWs Communications, a firm that consults with law enforcement on social media strategies. "With advances in geolocation technology, detectives don't just know what the criminal did, but where they did it. Social media can give them a solid and reliable way of piecing things together."

Many police departments first made the move online in child-predator investigations, in which a detective might pose as a child to snag a pedophile. But the techniques are now used in all areas of law enforcement.

"There was a time when if you handed a cop a laptop, he'd want to throw it out the window," says Boca Raton, Fla., police chief Dan Alexander. Now, most officers won't part with their iPhones, he says.

Gang-Busting

SOCIAL MEDIA HAS PROVED TO BE irresistible to gang members, says Bruce Ferrell, president of the National Alliance of Gang Investigators' Associations. Gangs use the medium to coordinate crimes and recruit new members, but they also like to show off, posting photos of hand signs, colors, weapons, drugs and cars, all of which can identify an individual as a gang member.

These digital clues have led to numerous busts. Last year, federal authorities arrested six members of East Side Riva, a Riverside, Calif., street gang, after finding communications the group had sent over Myspace and rap videos it had posted on YouTube to intimidate enemies.

In 2008, a multiagency task force arrested a Miami gang leader known as Bird Road Rudy after he posted a YouTube video of himself and his friends waving guns in the air and taunting Miami police. The courts

sentenced him to six and a half years in jail on federal weapons charges.

Why are gangbangers so eager to incriminate themselves? Mike Bostic, a retired Los Angeles Police Department assistant chief, chalks it up less to stupidity than to audacity. "The nature of gangs and criminals is that they can't wait to brag about what they're doing," he says. "They start posting on Twitter and Facebook, and all we have to do is sign up like everyone else and get into the system. Soon, we know what they're up to."

Police can also use evidence discovered on social networking sites as leverage during interrogations, says Jon Shane, a retired Newark, N.J., police captain who now teaches at John Jay College of Criminal Justice. Investigators can print out a photo from a suspect's Facebook page showing him at a party at which a murder occurred, and pocket it for when the suspect is brought in for questioning. "When he denies having been at the party, I know he's lying. I already have the evidence in hand," Shane says.

But social media evidence can also be used to exonerate suspects. Dennis Cleary, a criminal defense attorney in New Jersey, represented a woman accused of attempted murder. When the victim testified about her injuries, Cleary was able to contest her story because he found evidence to the contrary on her public Facebook page.

"She said she couldn't go to the gym anymore, she couldn't run anymore," Cleary says. "But she would post from the gym, on her cellphone, that she was on the treadmill."

Tracking Bad Behavior

FOR MONTHS, ABOUT 20 officers in the Toronto police department have been hunting for rioters who disrupted the G-20 summit there last June. Violence erupted after a group of anarchists broke from a peaceful march and torched police cars, smashed

The Digital Arms Race

COPS

VS

CRIMINALS

→ Law enforcement agencies routinely tap into location data from wireless phones during investigations.

→ Many police cars have cameras that automatically scan and check the license plates of passing vehicles against databases of wanted criminals.

→ A smartphone app called One Force Tracker helps tactical police teams by enabling officers to track one another's positions.

→ A technology called ShotSpotter uses microphone arrays to allow police to triangulate the location of the shooter in gunshot situations.

→ Drug dealers and gang members use prepaid "burner" phones, then dispose of them before cops can set up a wiretap. These phones have even been found inside prisons.

→ Thieves steal info from credit cards' magnetic strips with portable "skimmers" or via readers installed over legitimate ATMs.

→ Organized cyber-crime networks cover their tracks with antiforensic software such as Evidence Eliminator and Transmogrify.

→ Car thieves use GPS jammers to prevent systems such as OnStar from reporting a stolen vehicle's location to police.

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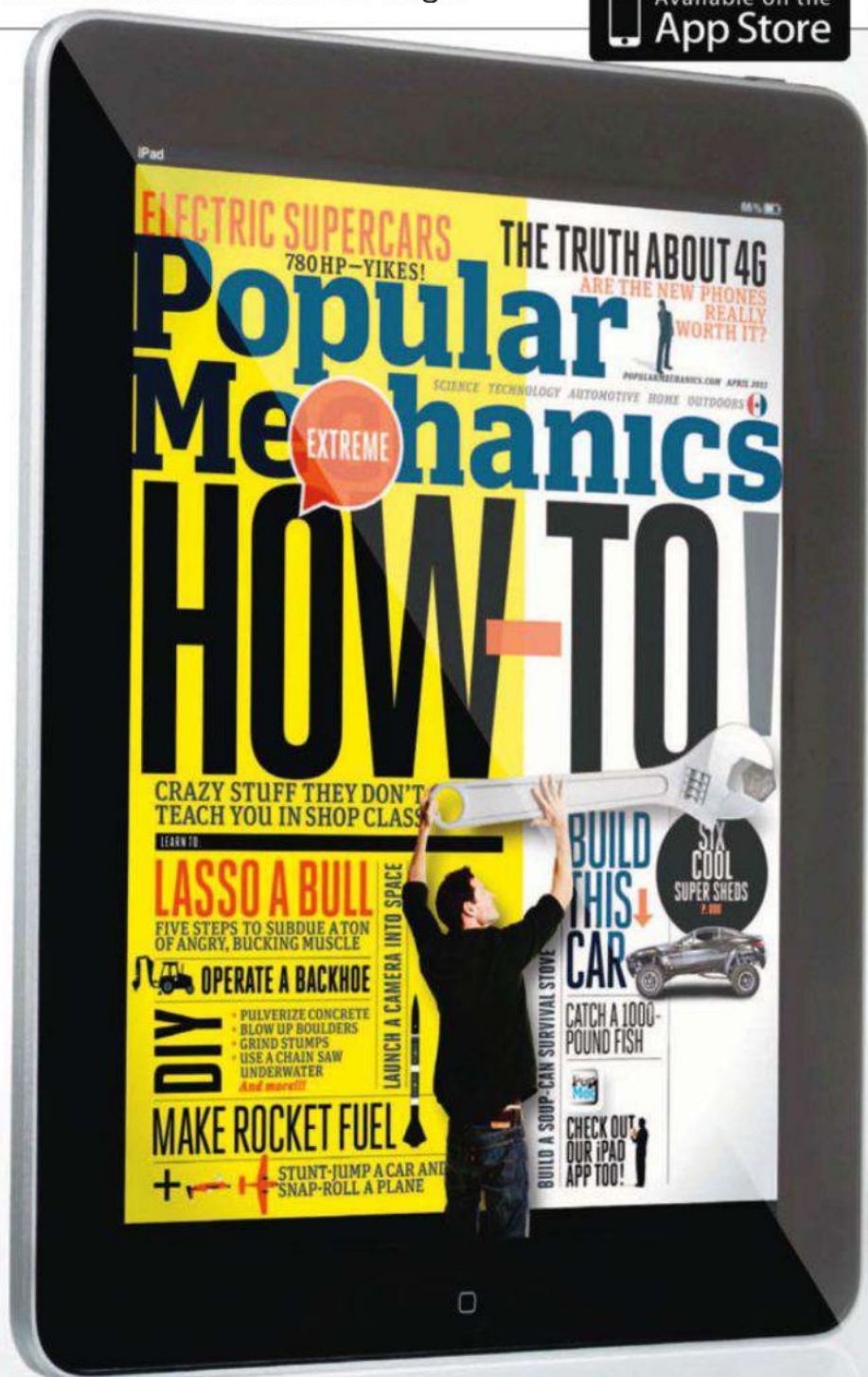
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POLICE TECH/// ANTISOCIAL NETWORK

storefronts and looted shops.

Anarchists routinely target G-20 summits, and one of the most potent weapons these groups use to sow chaos is the social-messaging site Twitter. (At the September 2009 G-20 summit in Pittsburgh, anarchist organizer Elliot Madison stationed himself in a hotel room with a view of the street, then tweeted directions to protesters to help them evade police.)

The Toronto investigators had monitored the Twitter feeds of some known anarchists before the conference. Now, says Toronto police detective Mike Jander, the police are friending suspects on Facebook, some of whom used photos of themselves kicking in the headlights of police cars as their profile photos. Thirty people have been arrested to date.

Jander says that for Toronto police, this case is personal. More than 1100 people were arrested during the mayhem that weekend—most of whom were let go—and police faced a barrage of criticism and cries of excessive force. Some working the case have become almost obsessed with finding the vandals, as a matter of honor.

“When you go home, you can’t stop,” Jander says. “You’re on Facebook or Twitter, because you have to see what so-and-so is talking about today. And then a new YouTube video comes out, and you go frame by frame to see who’s in the background.”

Because of their ability to reach a mass audience instantly, social posting sites enable instigators to assemble flash mobs that can quickly turn violent. Last spring, hundreds of teenagers gathered in Philadelphia’s City Hall area and began terrorizing pedestrians and employees of area stores and restaurants after they’d received messages about the meeting on Twitter and Facebook.

“We’re constantly monitoring them now,” said Lt. Frank Vanore, a spokesman for the Philadelphia Police Department.

They’re not alone. Many departments are now monitoring Twitter

and other social media for patterns in the chatter so they can predict crime—and hopefully prevent it—before it happens. Some law enforcement agencies are beginning to embrace social customer relationship management, or CRM, software, which was developed to monitor chatter from social networks for marketing purposes. Police are using social CRM for predictive analysis, letting the software raise red flags before an outbreak of violence.

Some departments use social media to solicit help from the public in solving crimes, like posting virtual WANTED posters. Detectives in Toronto found a murder suspect in 2009 by posting a YouTube video of a detective giving details of the murder and seeking help in finding the culprits. Police had already arrested one man but were looking for the second. Three months after the video was made, a man walked into a police station 30 miles away with information for “the detective on the computer.” It took police there 45 minutes to locate an office computer on which YouTube hadn’t been blocked. Once they did, they found the video and the name of the detective handling the case. Days later, police arrested the second suspect.

The Party Line

EVEN THE INTERNAL REVENUE Service monitors social media. In response to a Freedom of Information Act request by the Electronic Frontier Foundation, the IRS sent the group a 38-page training manual in which it outlines “Internet tools and searches that will be useful in locating taxpayers and determining their online business activity.”

Some civil liberties experts wonder whether police are going too far, entering areas for which they might otherwise need a search warrant. Do privacy rights extend to postings on a Facebook page? The answer, accord-

ing to legal experts, is not really.

“It’s the same as when police go undercover,” says Thomas Nolan, an associate professor of criminal justice at Boston University. “This is stuff in the public domain. It’s open to public scrutiny. It’s a solid, viable means of attaining investigative leads.”

Jennifer Lynch, a staff attorney with the Electronic Frontier Foundation, says people should have a reasonable expectation of privacy in their personal communications. But, she adds, “if a person accepts a friend request from someone they don’t know and then allows that person access to their private communications, the law is unlikely to find an expectation of privacy.”

James continues to pursue her drug kingpin. In 2009, her office began to monitor his associates’ cellphones and text messages. Investigators also slipped inside the organization’s stash house to do what’s called a sneak-and-peek. They found 3 kilos of cocaine, 16 bricks of heroin, \$80,000, two pistols and an AK-47. Police later rounded up members of the organization. But when they tried to catch the kingpin in the parking lot of a shopping mall, he took off, vaulting over a fence and an 8-foot wall, then disappeared into traffic.

Last year, James heard that one of the drug dealer’s friends was sending encoded messages from his Facebook page to let people know the kingpin was all right, but she went to that page and found nothing. What she really hopes to find is the dealer himself, lurking, like her, behind some false online persona.

“He’s sneaky. There’s no way he’d use his own name on Facebook,” James says. “But I scroll through his friends’ lists looking for things like his son’s name, which is unique.” James hasn’t found him yet, but she’s confident that the online conversation will ultimately prove too hard for him to resist.

PM

Some civil liberties experts wonder whether police are going too far, entering areas for which they might otherwise need a search warrant.

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I used to be more active. I used to run, play basketball, tennis, football... I was more than a weekend warrior. I woke up every day filled with life! But now, in my late 30's, I spend most of my day in the office or sacked out in front of the TV. I rarely get to the gym - not that I don't like working out, it's the nagging pain in my knees and ankles. Low energy and laziness has got me down. My energy has fizzled and I'm embarrassed to admit that I've grown a spare tire (I'm sure it's hurting my love life). Nowadays I rarely walk. For some reason it's just harder now. Gravity has done a job on me.



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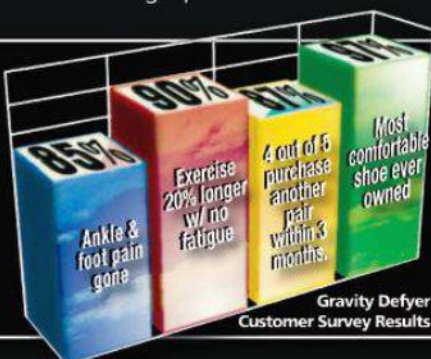
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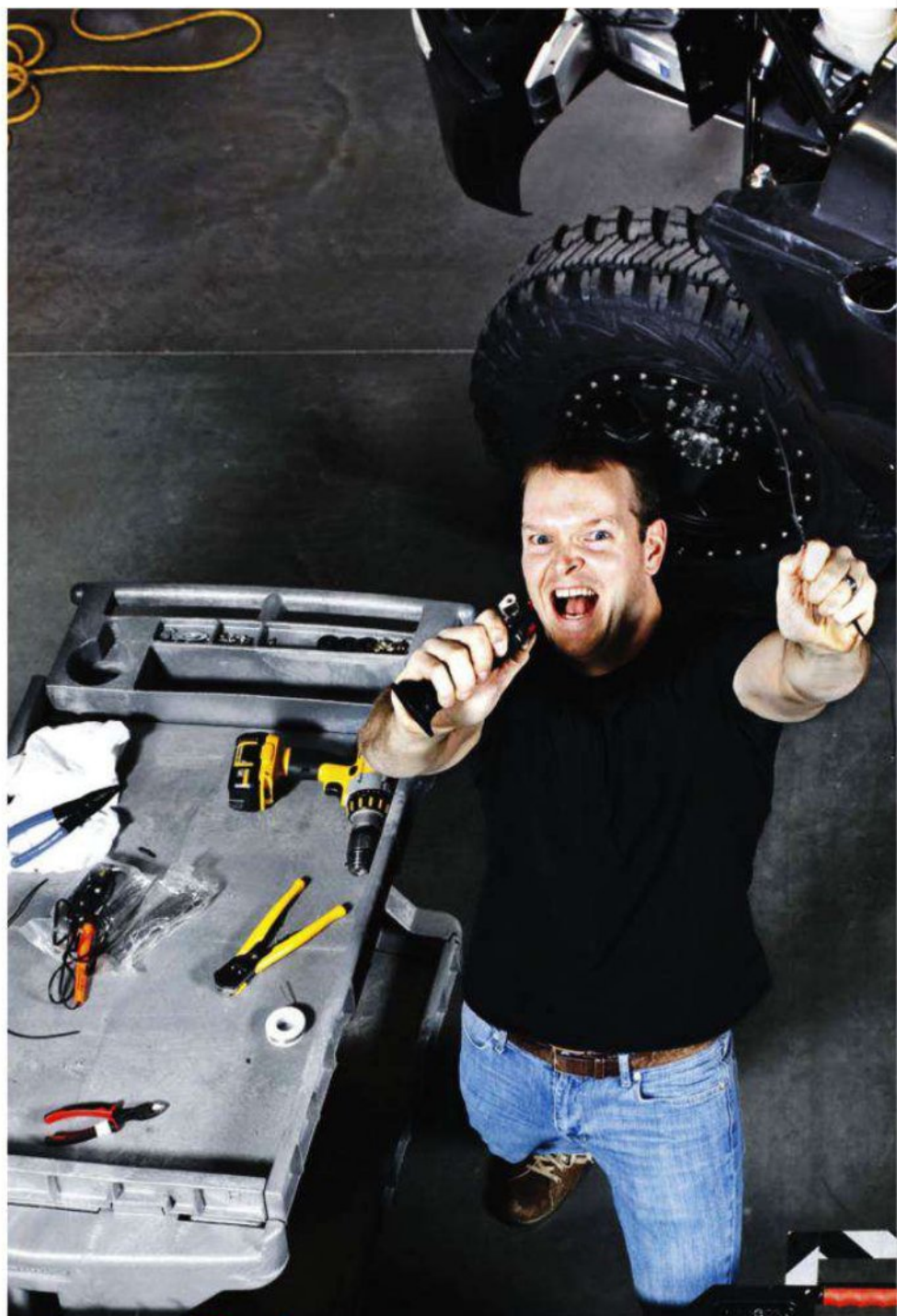
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BUILD A CAR

A LITTLE COMPANY CALLED LOCAL MOTORS HAS TAKEN A BIG, RADICAL BUSINESS PLAN—CROWD-SOURCED DESIGNS, MICROFACTORIES, CUSTOMER-ASSISTED MANUFACTURING—FROM THEORY TO REALITY. NOW, WITH ITS FIRST CAR, THE RALLY FIGHTER, ENTERING PRODUCTION, PM GETS BUSY WITH SOME GOOD OLD-FASHIONED WRENCH WORK. **BY EZRA DYER**

Writer Ezra Dyer roars like a DIY lion at Local Motors, in Phoenix. He says the last car he built was made of Legos.

Degree of difficulty is on a scale of one to 10, with 10 being the most difficult.



THE UNMISTAKABLE FEEL OF METAL SCRAPING SKIN FORCES ME TO LOOK DOWN AT MY RIGHT hand. I see blood welling up from the middle knuckle of my index finger. I had thought that the space beside the transmission tunnel of Local Motors' Rally Fighter (think: a street-legal version of *Mad Max*'s desert racer) could accommodate both my hand and a seat track. But it couldn't—at least not while I was trying to wrestle the seat into position and bolt it to the floor—and now I have a slice in my flesh.

I turn to Mike Pisani, one of Local's R&D engineers, and explain that he must have ordered a batch of defective seats. There's no way these fit. He calmly nods toward the other three cars on the line. They all have seats. Which means that if there's a problem, it's not with the hardware but with the goon holding the wrench. Therein lies the beauty and the challenge for Local Motors and its customers: You can't just walk into a dealership and buy a Rally Fighter. You have to roll up your sleeves, grab a ratchet and help build it.

The process that led to my newbie car-building moment can fairly be described as unprecedented. Local Motors CEO John "Jay" Rogers Jr. hatched the idea for Local Motors while he was at Harvard Business School, where the concept won the annual Pitch for Change contest during the 2006 to 2007 academic year. Before Harvard, Rogers had served for six years as a U.S. Marine Corps infantry commander. Which means he could kill you with his bare hands, but he'd have to make a business case for it first.

Rogers's big idea is to harness the creativity of under-employed industrial designers, art-school students and car-design geeks—people who have notebooks full of sketches but lack the means to produce a vehicle. But instead of one designer providing a few options, an online mob goes to local-motors.com and submits 10,000 schemes for cars (actually, more than that at last count); the coolest ones rise to the top, based on voting by the LM virtual community. Winners receive \$10,000 and a childhood dream come true: seeing a car they drew go into production. That's how Sangho Kim, a student at the Art Center College of Design in Pasadena, Calif., turned the wild idea of an off-road P-51 Mustang fighter plane into a rolling reality. "I was totally inspired by the P-51," says Kim, who now works as a designer for GM Korea. "I was searching for what could make a strong, bold and sexy car. The P-51 has a really cool silhouette and American DNA."

After Kim's design was selected, Local Motors built its first production facility near Phoenix, hewing to the company's plan to set up microfactories in whichever area suits a given car. The Rally Fighter's specialty is fast off-roading in the desert, so Phoenix fits the bill. Other designs, not yet in production, include the Green Apple, a compact electric car with a windmill generator and enough moxie to survive in the Big Apple, and the Miami Roadster, a "modern, hot" car that provides "elegance in an aggressive package,"

according to LM's website.

Practically speaking, Pisani says, "there are four major impediments to building a car: tools, time, space and ability." Local Motors takes care of the tools and space. I've got plenty of time. So for my Rally Fighter build, ability is the wild card.

The finished product will be roadworthy, of course, but different from a conventional set of Detroit wheels. Its DIY pedigree and certain details—for instance, it has seatbelts but no airbags—dictate its registration as a custom- or homebuilt vehicle. If you're thinking kit car, you're on the money. But Rally Fighter buyers don't build the car in their garage; instead, they spend two weekends at the factory, enjoying expert help. The last time I built a car, it was made out of Legos. But with Pisani's guidance, I'm up for the task at hand. I think.

PISANI LEADS ME TO A ROLLING CHASSIS AND ticks off our to-do list: Install the aluminum honeycomb trunk walls, assemble the trunklid, and fit the body over the steel-tube frame. We'll also deal with my nemeses, the seats. I'm fascinated by the naked Rally Fighter, with its immense Fox Racing remote-reservoir



TIP

At Local Motors, tools are color-coded for each task and replaced after use. This makes the build process faster and more consistent and prevents tool loss. There's a lesson in this, especially if you occasionally work in a friend's garage: Mark your tools and put them back in your kit right away.



THE BUILD



Big tasks, like bolting on the body, are instantly gratifying. The real challenge is adding the small but critical parts (brake lines, wiring, etc.), which takes hours.



EXPERT



The biggest hurdle in a DIY project is between your ears. "Don't fret about what you don't know," says John "Jay" Rogers Jr., founder and CEO of Local Motors. "The journey is what's worthwhile, and there's no better education than simply getting started."

shocks. While a BMW diesel powered the development car, all the vehicles here on the floor are fitted with a GM E-Rod LS3 V8 crate motor. It's not as novel as the BMW straight six, but it has the advantage of 50-state emissions compliance—and 430 hp to the BMW's 265. In its current, bodiless state, the Rally Fighter shows how it maximizes the use of off-the-shelf parts. The rear end is from Ford, as is the steering gear. The gas tank wears a BMW part number (M3 tank, 16.6 gallons; M5 pump). The front and rear bumper structures are Mercedes. For a car that will cost about \$60,000, this thing has some fancy innards.

Our first task is to install the trunk walls. That means fitting weatherstripping to the top edges of the panels and then bonding the walls into place with angled aluminum and Plexus adhesive. If you've never used Plexus—and I haven't—the important message seems to be that you shouldn't let it touch two things that you don't want stuck together forevermore. Thankfully, I'm able to draw a tidy bead with the glue gun and get our walls clamped into

THE CAR

Produced in Phoenix, the Rally Fighter is the mother of all kit cars, built with professional assistance in a factory, not a garage. Its design was selected from thousands submitted to the Local Motors website. The use of existing parts holds down costs and leverages research and development by other companies. LM makes some components, such as the carbon-fiber-and-fiberglass body.

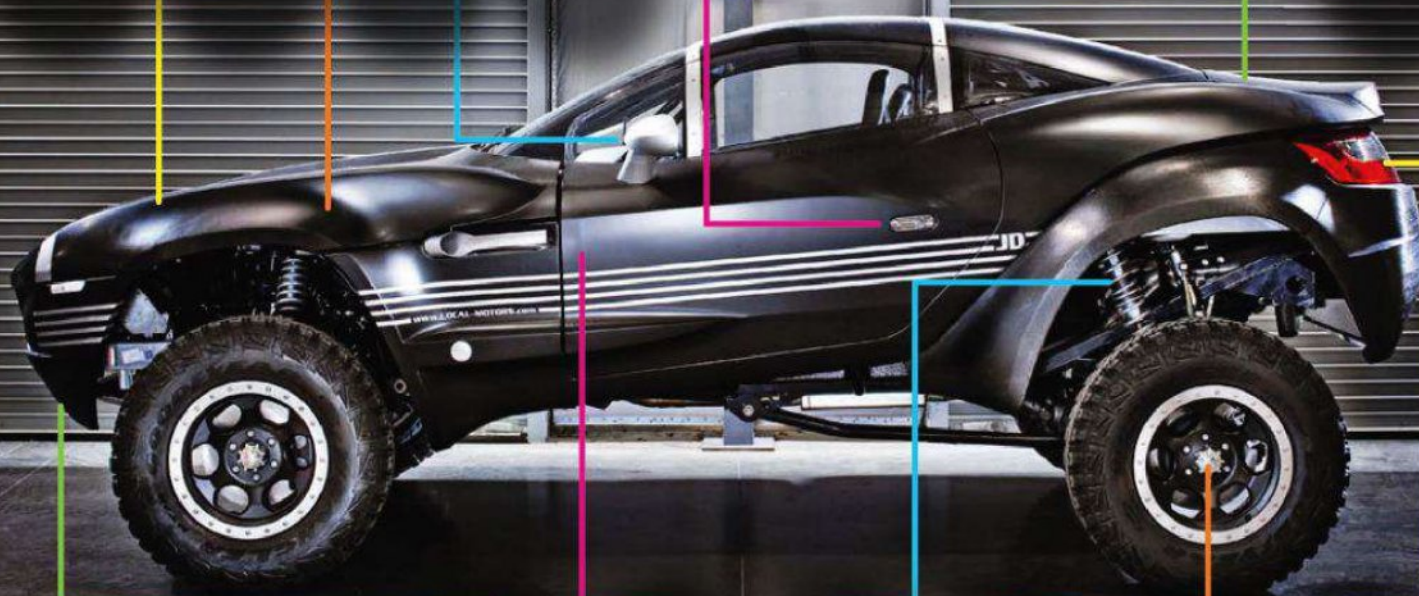
Engine:
Corvette/
GM 430-hp
6.2-liter
V8

Chassis:
steel-tube
frame built
by LM

Mirrors:
Dodge
Challenger

Handles:
Mazda
Miata

Gas Tank:
BMW M3
(16.6
gallons)



**Bumper
Structures:**
Mercedes
E-Class

Body:
LM; vinyl
coating cuts
12 pounds

Shocks:
Fox
Racing

**Brakes,
Rear Axle:**
Ford
F-150

Taillights:
Honda
Civic

place without inadvertently gluing my head to the rear suspension. This car-building stuff is easy.

At least that's what I think until I'm tasked with installing the seats. Each one is mounted on a rail, and the mounting holes play peekaboo depending on the seat's position on the rail. That precipitates a chicken-and-egg conundrum, since you can't easily slide the seat on the rails until it's mounted, but it's hard to mount the seat without moving it along the rail. As I struggle to get the seat into position, I notice there's a lot of swearing going on around here. And it's all coming from me.

With that frustrating task behind me and my knuckle bandaged, I move on to the rewarding part: dropping on the body. The upper shell—roof, rocker panels and front fenders—is fiberglass; the lower parts that are subject to abuse, such as the bumpers and rear fenders, are carbon fiber. The shell weighs just 150 pounds, so Pisani and I easily lift it into place. Next, we tackle the trunklid. Housing the taillights, a latch, hinges, license-plate lights and the center brake light, the humble trunklid has a lot going



GLOSSARY

custom-built (kus' tām bilt) (*adj.; n.*) Put together from scratch and not mass-produced; any vehicle that meets this description. The Rally Fighter, kit cars and other motorized DIY vehicles fall into this category. Although the term varies from state to state ("home-built" is the most common synonym), all custom-builts require different inspection and registration processes from those applied to, say, a Chevy or Volkswagen. While not necessarily unsafe or more polluting than mainstream vehicles, custom-builts don't meet federal emissions and safety standards before production. This is why states apply a separate set of regulations to the vehicles.

on. And that's before you install it.

Pisani and I attempt to bolt on the hinge brackets, but the holes aren't lining up with the chassis. The trunk's weatherstripping is slightly thicker than originally planned, so the brackets are slightly off. Pisani removes a bracket and drills out the mounting holes. Now it fits. "After we finish, we'll take the measurements and change the CAD data so that the next ones will bolt right on," he says. "We could just keep adjusting each one, but that's the hack way to do things."

We move on to the trunk wiring, which requires a couple of spots of solder. I confess that I've never soldered anything, and Pisani gives me a quick tutorial. This, too, is part of the process: If there's a technique or tool that's unfamiliar, the Local Motors crew teaches you how to do it. And it turns out that soldering is great fun. You're using fire and liquid metal, which is elementally satisfying.

Come to think of it, the whole procedure is satisfying. You're handling tools and bonding metal, watching a car take shape. But the really difficult tasks are handled by the pros. You get the validation of seeing your work translated into a tangible (and, in this case, fierce-looking) machine, without the fear that you'll get 20 hours into the assembly and then realize that you installed the first component backward. As my workday winds down, the Rally Fighter is a little more complete than it was when we started. It's gone from a naked chassis to something that looks like a car rather than a dune buggy. But it's not yet ready to hit the trails. For that, we'll be using Rogers's own Rally Fighter, one of the first V8 cars to roll out of the factory. That car is finished. Almost.

THE NEXT DAY, I ARRIVE AT THE FACTORY, A sprawling ex-RV warehouse on the outskirts of an industrial park. Engineers Colby Whipple and Alex Fiechter are doing some final transmission calibration on the Rally Fighter that I'll be driving. Our plan is to take it on an off-road shakedown that'll throw us a little bit of everything: high-speed washes, narrow forest trails and steep climbs. We'll head into the mountains, to Crown King—an old mining town that's still home to 100 hearty settlers—and our ultimate destination, the Crown King Saloon, where we plan on



Local Motors installed a steel ramp outside the factory for monthly stunt shows. Here, the Rally Fighter flies 15 feet in the air.

having a celebratory beer and burrito. After we spend the morning and early afternoon adjusting the four-speed automatic's shift points, the Rally Fighter is packed into a trailer, and we head for the hills.

By the time we arrive at the trailhead, daylight is already fading. Rogers and Fiechter climb into the diesel Rally Fighter while I slide behind the wheel of the V8 car, with Local's chief sales officer, Sarah Stokes, in the passenger seat. Making me feel like a supreme underachiever, Stokes is a very attractive triathlete who was also in the Marines and went to business school at Harvard. Rounding out our posse, Local Motors engineering intern Tony Rivera and our photo crew pile into a Ford Raptor that I brought along on the thesis that it would be the only production vehicle that could remotely keep pace.

We set out on a dirt road that soon deteriorates into a track through a riverbed. I quickly learn to modulate the throttle, because power oversteer is effortless when you're trying to put down 430 hp on dirt. Donning my car-reviewer hat, I'd go for a steeper rear end to bring up the revs, softer rear springs to encourage more squat and padding on the roll cage to quell rattles. But the basic package works extremely well, especially in its intended milieu.

Rogers seems to be gunning for the unofficial Lake Pleasant-to-Crown-King world speed record. As a result, I'm lost in a sort of super-focused driving fugue. All of my brain neurons are devoted to processing this experience.

HOW TO: BUILD A CAR

I'm probably drooling. And the Rally Fighter is working brilliantly, its daddy-longlegs suspension soaking up the hits without bouncing us into, for example, an enormous bull who suddenly appears trailside.

After safely passing the livestock, we stop for a break. The V8 Rally Fighter protests the idling with a jet of steam from the radiator. The fan fuse has blown again. Rogers is confident that if we keep moving, the cooler nighttime temperature, about 45 F, will make the finicky fan a moot point. We get back onto the trail, but shortly thereafter I pull up on Rogers's taillights at the start of a boulder field. I assume he's stopped to pick a line, but when I get out to talk, I see that the line already picked him: His Rally Fighter's left front wheel is splayed out at a gruesome angle.

To my relief, Rogers produces a replacement part—the steering-knuckle stud bolt—and then crawls under the car to install it. “We knew this was a weak point on the development car, so we beefed it up on the production cars,” Rogers says as he aims a flashlight at the rogue component. You've got to respect a car-company CEO who can rebuild a front end on the kind of trail that has the desert-hero Raptor creeping along in low range.

The trail opens up, and I challenge myself to try to keep up with Rogers. Every few miles the trail forks, so we stop to make sure we don't lose the Raptor. Tony, when he catches up, gives the Ford its due. “If I were driving something like a Tacoma, you'd be waiting a lot longer,” he says. “With a regular 4x4, this trail takes 8 hours.” With a Rally Fighter: 3 hours. The 40 or so miles up to Crown King don't come easy.

Before long, the Saloon reveals itself through the trees, an oasis of cold beer beckoning our dusty throats. Two grizzled locals stand on the porch and appraise the alien off-roaders. “You came up from Lake Pleasant,” one of them says, “with two-wheel drive?” He says this with an air of disbelief, as if he might call our bluff and climb under the nearest car in search of front halfshafts. The other guy clearly appreciates the Rally Fighter's styling, declaring the car “prettier than a brand-new chain saw.” Okay, perhaps he was actually talking about Stokes. But he seemed to like the cars too.

I'm just relieved to be here. If either of these two cars had become irreparably broken out on that trail, that would've been my story. And, journalistic impartiality and fear of mountain lions aside, I didn't want that story. Because this a company you want to root for.

Local Motors' debut product isn't a traditional kit car, but it's not a mainstream production car either. It's more exclusive than many exotics, but it's not outrageously expensive. The Rally Fighter is, in its way, sort of like an off-road, American version of a Lotus—a car that's rare but attainable for mortals, built by a small, focused company of gearheads. And you. **PM**

DEGREE OF
DIFFICULTY



EXTREME HOW TO



**BY
ROBERT
MORITZ**

LEARN TO DO INCREDIBLE THINGS WITH THESE OBJECTS:

CAMERAS
ROCKETS
AIRPLANES
FISH
BACKHOES
STUNT CARS
PULSE JETS
REDWOODS
ROLL CAGES
HOUSES
BULLS

**PLUS: 7 EXTREME
TOOLS THAT
INSPIRE FEAR
AND DESIRE**

DIAGRAMS BY CYPHER13

LAUNCH A CAMERA INTO SPACE

MIT students Justin Lee and Oliver Yeh stuffed a camera in a cooler, tied it to a helium balloon, and—with FAA approval—launched the rig 17.5 miles into the stratosphere. “The results were fantastic,” Lee says. “We tracked the device with a GPS-enabled cellphone and found it 20 miles from the launch site.” The 5-hour flight, which cost \$150 in materials, took photos of Earth every 5 seconds. Then, at 90,000 feet, the balloon popped. See the results at 1337arts.com.



-  Weather balloon
-  Parachute
-  Aluminum foil
-  Newspaper
-  Hand warmers
-  Camera
-  Antenna

1. Find a Site The ideal is a flat, treeless site, at least 100 miles from a military base, on a calm, clear day. Give the FAA 24 hours' notice.

2. Prep the Gear Set the camera to shoot automatically at $\frac{1}{800}$ sec shutter speed. Program a cellphone to send GPS coordinates after the flight.

3. Pack a Capsule Cut holes in a cooler for the camera lens and phone antenna. Zip-tie the cooler to a parachute and balloon.

4. Test; Launch Lee and Yeh tested impact resistance by putting eggs in the capsule and dropping it from a rooftop. They also froze the camera.

PHOTOGRAPH BY ESSDRAS M. SUAREZ/BOSTON GLOBE



Check with the FAA to prevent launching into restricted flight zones, and check that the payload is within the 5-pound limit. Use a balloon-trajectory predictor to make sure the capsule won't fall in a city. “That could be quite dangerous,” Lee, above right, says.

DEGREE OF DIFFICULTY



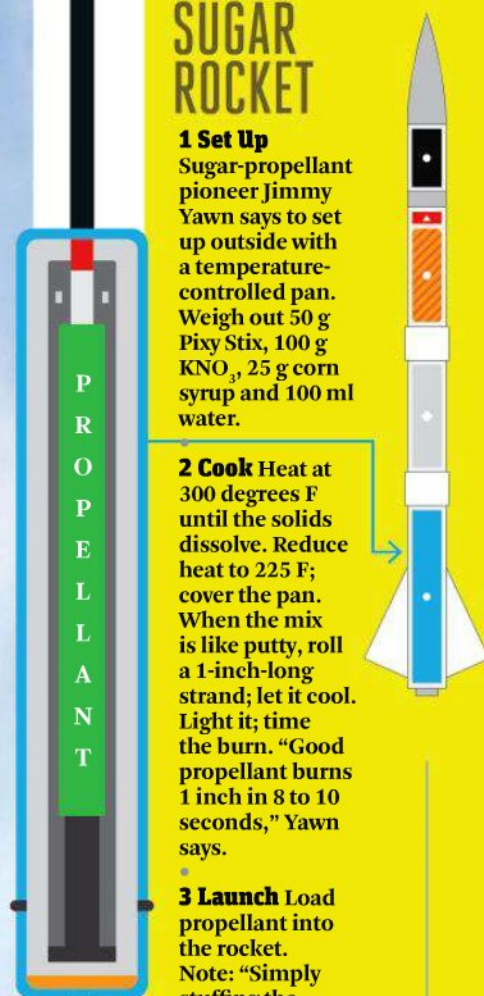
BUILD A SUGAR ROCKET

1 Set Up

Sugar-propellant pioneer Jimmy Yawn says to set up outside with a temperature-controlled pan. Weigh out 50 g Pixy Stix, 100 g KNO₃, 25 g corn syrup and 100 ml water.

2 Cook Heat at 300 degrees F until the solids dissolve. Reduce heat to 225 F; cover the pan. When the mix is like putty, roll a 1-inch-long strand; let it cool. Light it; time the burn. “Good propellant burns 1 inch in 8 to 10 seconds,” Yawn says.

3 Launch Load propellant into the rocket. Note: “Simply stuffing the propellant into a casing does not make it into a rocket motor,” Yawn says.



DEGREE OF
DIFFICULTY



ROLLA STUNT PLANE

A snap roll is a high-speed 360-degree rotation of an aircraft on its yaw axis, the line perpendicular to the wings. Five-time U.S. National Aerobatic champion **Kirby Chambliss** says a snap roll feels “five or six times more intense than the craziest roller-coaster ride.” So it’s surprising to hear Chambliss, who flies up to three times a day, six days a week, say he could coach the average person to do one in about 30 minutes. “You don’t need to be a pilot—the plane doesn’t know you don’t know how to fly it,” he says. “Some pilots are worse at it. They’re not used to flying upside down.”

“It’s common to get stuck flying upside down,” Chambliss says, “but the ultimate nightmare scenario would be the wings coming off the plane.” That’s why he uses only an aerobatic aircraft—such as the Zivko Edge 540—for stunts. “The only way to damage that plane is if it hits the ground,” he adds. Crashing also qualifies as a nightmare scenario.

WARNING



The plane will be spinning at the rate of about 500 degrees per second. “In a fraction of a second, the world will explode right in front of you,” Chambliss says.

Zivko Edge 540



1. Pull Back Get the plane up to 120 knots. Rapidly pull back the control stick to cause upward force on the plane’s nose.



2. Stall the Wing Step on the right rudder pedal. The left wing lifts and moves forward while the right wing stalls.



3. Level It Out Guide the stick forward and depress the left rudder pedal to re-engage airflow to the right wing.

DEGREE OF
DIFFICULTYCATCH A 1000-
POUND FISH

Charter a boat, drop your hook and wait for a strike. "In the first 5 seconds, you realize you have a live Patriot missile at the end of your line," veteran offshore angler Charlie Levine says. "A good captain shouts, 'Reel! Reel! Reel!' as he turns to chase the fish. With a fish that size, reeling it in can take all afternoon."

TIP



To find the right charter boat, join a forum on a site like bloodydecks.com, get a referral and call the captain. A good one will promise little and put you in touch with a previous customer for a testimonial.



KEY TOOL **Fighting Chair:** Bolted to the deck of the boat and harnessed to the rod, the swiveling chair lets anglers brace their feet in footholds and leverage their body weight against the fish.

DEGREE OF
DIFFICULTYOPERATE A
BACKHOE

You've wanted a backhoe since age 6. So rent one! Here are the basics of the 7-ton behemoth.

EXPERT



Case Backhoe Rodeo Series champion Nick Market wasn't always a backhoe phenom. "You really need a lot of seat time before you get good," he says.

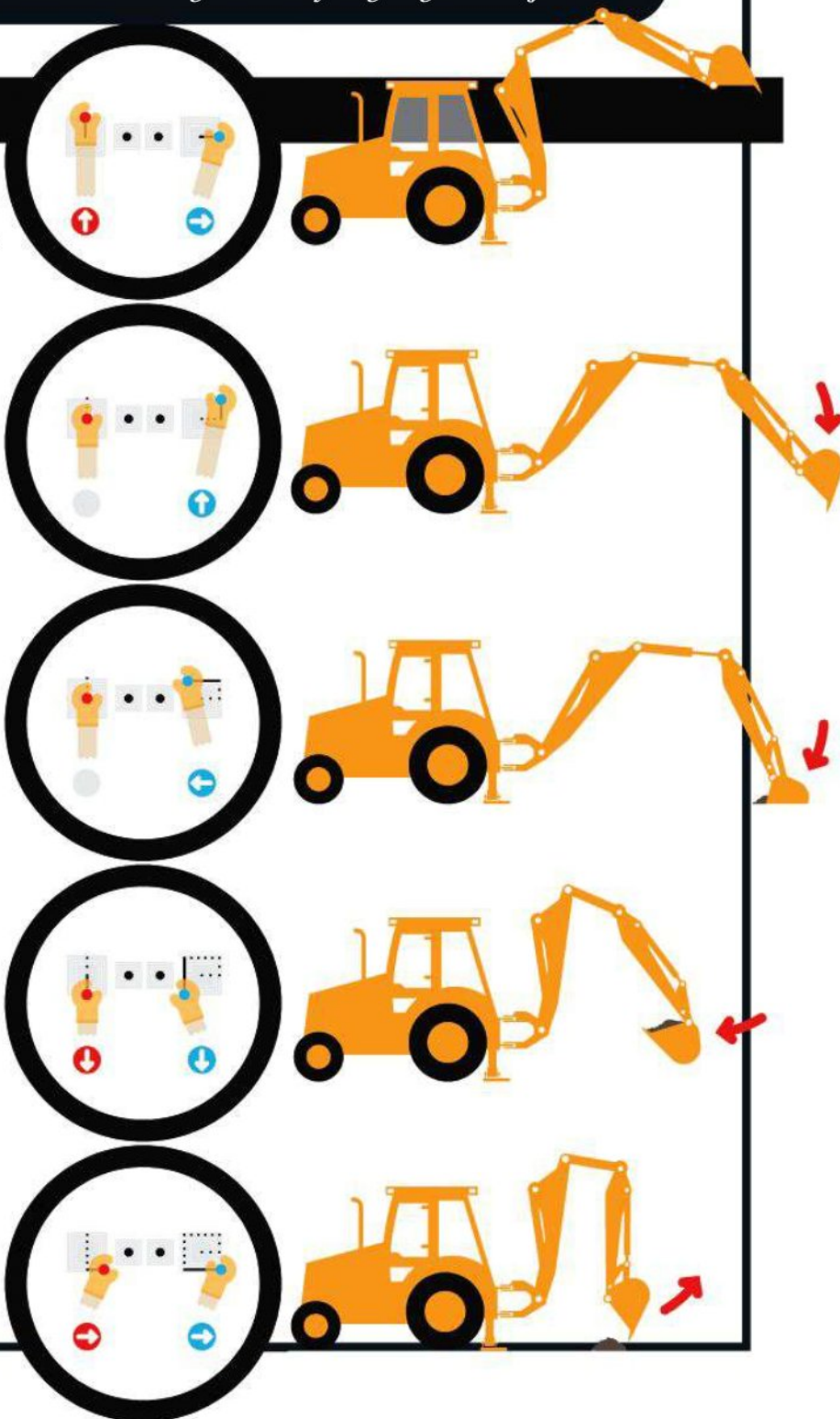
1. Open the Bucket "I'm at the point now where I can move the machine like my own body," Nick Market says. "The key is to get a feel for the hydraulics." First, put the stabilizers down to steady the backhoe, and release the boom lock. Push the left control forward to extend the backhoe's stick. Push the right control to the right to open the bucket.

2. Lower the Boom "Be aware of what's around you," Market says. "Be especially careful digging around utilities." Push the right control forward to lower the boom.

3. Start to Dig Push the right control to the left to curl the bucket inward, lowering it into the ground to scoop up soil. "It's usually a good idea to go in at an angle," Market says.

4. Lift the Load Pull the left and right controls back at the same time to retract and raise the boom while keeping the bucket curled. "Don't overfill the bucket," Market says. Most backhoes have a reach of 14 feet. A device called an extend-a-hoe adds another 4 feet of reach.

5. Dump the Dirt Push the left and right controls to the right to open the bucket, pull the stick toward the cab and dump the load. "Don't raise the load up too high," Market says. "There's a major tip factor there." He also operates the machine at full throttle. "It's all about precision, control and speed," he says.



HOW TO: EXTREME TOOLS



DEGREE OF
DIFFICULTY



MONOSHOCK RAM

Ballast slides like a piston inside a door-breaching battering ram.

Members of law enforcement grip flexible handles on Blackhawk's 4-inch high-density polyethylene tube. When swung into a locked door, the ram's internal weight slings forward, amplifies force and isolates the impact shock from the user. Have ID ready: Sales to civilians are prohibited.



PICKAROON

Chopped lumber flies to the woodpile when skewered on the pickaroon tip.

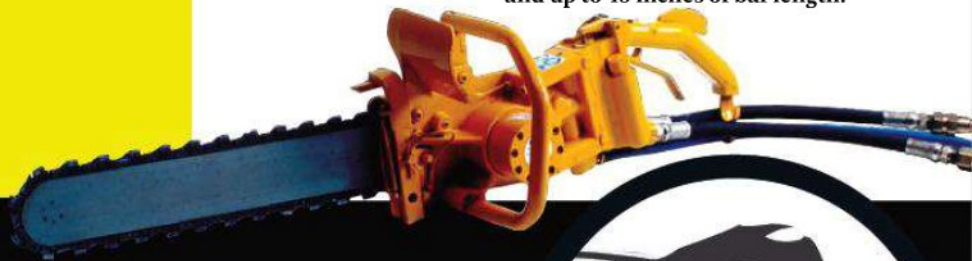
The 36-inch pickaroon punctures log ends to move firewood as fast as a helper can buck it. It looks deadly, but pickaroon.com's Johann Hoche says there's just one big danger: "If you don't stick it good in a log, it could pop out, and you'll go over backward," he says.



UNDERWATER CHAIN SAW

Holler "Timber" into your snorkel and clear-cut the pond.

Demolishing underwater dock and bridge pilings is easy with Stanley's CS11, an anti-kickback saw for underwater arborists in need of a 2000-psi hydraulic motor and up to 43 inches of bar length.



DEGREE OF
DIFFICULTY



STUNT-JUMP A CAR

"With a ramp-to-ramp jump, a center section or tabletop is in place during test jumps to establish speed and height while not damaging the equipment," says Formula D racing champion and Hollywood stunt driver Rhys Millen. "Then the center section is removed to expose an impressive height and gap." The ramps can be made in a day. Perfecting the jump distance varies based on the car's suspension, weight and wheelbase and the balance of the car at a certain speed. "With a good stunt coordinator and correct setup, the jump is the easy part."

EXPERT



A veteran of The Dukes of Hazard and three The Fast and the Furious films, Millen was the first person to successfully back-flip an off-road truck.

1



2





CONCRETE SMASHER

Driveways don't stand a chance against the king of the pavement pulverizers.

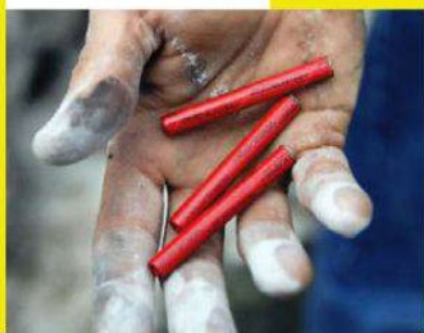
With 900 blows per minute and 61 ft-lb of impact pressure, the \$1700 DeWalt pavement breaker earns its keep. One Northern Tool customer testimonial is titled, "What sidewalk?" Another user put it through 12 inches of 6000-psi concrete. Chuck the 3-inch chisel, clear the area of any flammable liquids, get your boots out of the way and reduce Quikrete to its powdery aggregate origin.



BOULDER BLASTER

Bomb rocks out back with a dyn-o-mite explosive kit.

Drill 10-inch-deep holes into a large, bothersome rock. Clear dust from the holes, drop in a pair of Micro-Blaster charges (below), insert firing pins, connect a pneumatic line and detonate from 25 feet. No license required!



STUMP GRINDER

Stop suffering with unsightly stumps.

PM contributor Joe Truini once spent an entire day trying to clear a stump with an ax, a shovel, a hoe, a pick and a chain saw. "Ended up with a hole the size of a Buick, and still couldn't get the stump out," he says. Truini had better luck with a Vermeer SC252 stump grinder, a 27-hp machine with a 16-inch-diameter cutting wheel. It bit off 3 inches at a time, sweeping side to side until the stump became a 4-inch crater. It took 90 minutes.



TRUCK WINCH

A 15,000-pound winch bulks up the big trucks.

Straighten a sagging barn, haul a log or tow a Civic out of a ditch—with a winch, it's a cinch. Anchor the truck, align the winch for a straight-line pull and stand clear. Re-spool wire rope evenly across the winch drum.



1. Get Going Have a long lead-up to avoid unsettling the car before flight. Long-distance jumps can require a high speed of 65 to 95 mph, but most jumps are made at speeds between 35 to 45 mph.

2. Hit the Ramp An elevated kicker at the ramp's edge lifts the car's nose. It descends into the ramp as the rear wheels pass.



3. Fly Straight "When you leave the ramp, lift out of the throttle," Millen says. This makes for a more even flight, with no twisting. In a nose-dive, hit the throttle to lift the nose of the car.

4. Land That Thing In most cases, the car falls nose first. If the nose tends to drop too much, a 300- to 500-pound weight is added to the trunk.



KEY TOOL

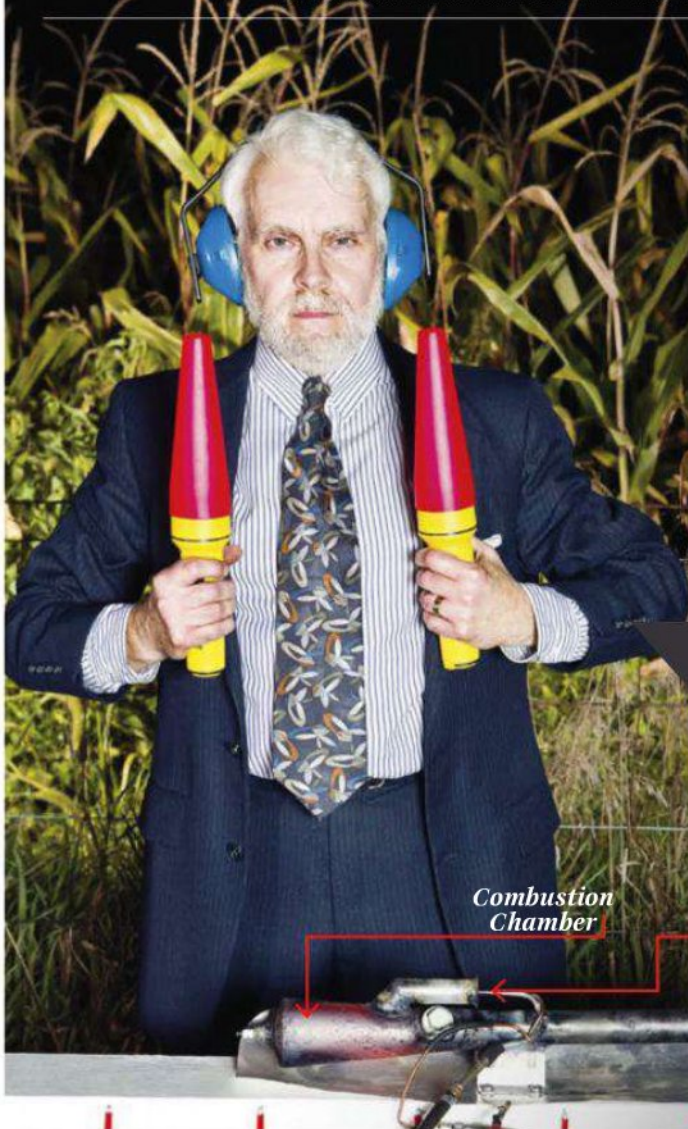
Bungee Seat: Millen rides in a cradle-like seat suspended from the roll cage. Held from straps under tension, the seat saves the driver's back from compression as the car lands.

DEGREE OF
DIFFICULTY



BUILD A PULSE JET

Bellowing up to 140 decibels, a valveless pulse jet drastically accelerates the speed of bicycles, scooters, skateboards and carousels. "The most common misunderstandings are the engine's fuel flow—lots—and the starting air—a trickle," pulse-jet expert Larry Cottrill says. Here's how he makes one from scratch in 8 hours—"and I don't even have a decent shop," he says.



Build a Chamber

Cut 22-gauge mild sheet steel, tracing a pattern with aircraft snips, to fabricate a two-piece combustion chamber. Using a pipe anvil and mallet, roll a long open cone. Use the mallet to form a blunt dome to cap the cone. Weld each cone's seam. Drill a hole in the dome's tip and weld on a spark-plug mount nut.

Make a Tailpipe

Cut and file an exhaust tailpipe and an intake pipe from lengths of thin-walled tubing. Use a ball-peen hammer to flare each end. Fit the narrow end of the chamber cone into the exhaust.

Connect It Weld the dome and the tailpipe onto each end of the combustion cone. Cut a hole in the cone side for a port to fit the intake pipe.

Mount and Fire

Fit the rig onto a Bukowsky mount. Arrange a propane torch so the flame goes across the tailpipe opening. Light it and blow air in.

GLOSSARY

Bukowsky Mount: A simple rack that uses a hose clamp to secure the tailpipe to a rear bracket while the spark plug connects to a front bracket. The mount prevents the engine from moving when ignited, and a built-in heat shield protects the operator.

DEGREE OF
DIFFICULTY



MOVE A HOUSE

Cut the Utilities

Jay Thompson of Atlantic Structure Movers disconnects water, sewage and electricity lines, then drills through the foundation and slides steel beams under the house.

Jack It Up

Thompson pulls a lever on a Jahns Structure Jacking System to send hydraulic fluid into the jacks under the steel beams. Daylight appears beneath the house.

Crib the Crib

Jacks raise the house, the crew supports it on cribbing, and then it is jacked up to truck level. "We've moved homes with all the furniture inside," Thompson says.

Truck It Away

Thompson slides a flatbed beneath the building, and friction alone holds it in place for the journey. At the new lot, he removes beams and cribbing, then lowers the house to its foundation.

DEGREE OF
DIFFICULTY



CLIMB A GIANT TREE

Tree Trek Exploration founder Wild Bill Maher uses the double-rope technique to climb 200-foot redwoods. Harnessed in a saddle with a sling around a branch, Maher never climbs with spikes—but he does sleep up there.

Find a Tree In a five-day class, Maher trains novices for a guided climb. Solo climbers can find a safe tree on the U.S. Forest Service's tree-climbing page.

Rope a Branch On a 200-foot tree, the lowest branch is 80 feet off the ground. Sling a weighted bag over it and tie the climbing rope to the throw line.

Saddle Up Sit in a climbing saddle. Slip your feet into rope loops. Tie a sliding hitch knot. To climb, pull down on one rope and slide the knot up. At the first branch, tie into the tree. Toss the throw bag to the next branch and go.



PHOTOGRAPH BY COLBY LYSNE (LARRY COTTRILL)

TIP



To fine-tune a house's position in a new location, Thompson uses tilted jacks that rest on rolls of foam padding. As the jacks take on weight, they straighten and shift the house into place. "If I get all four jacks tilted in different directions," Thompson says, "I can rotate the house."



HOW TO

DEGREE OF
DIFFICULTY



EXPERT



Dennis McCarthy, a car coordinator whose work appears in *The Green Hornet*, has built stunt and race cars for 20 years. "Beware the first-time roll-cage builder," he says.

WELD IN A ROLL CAGE



Prep the Interior Strip the cabin to reveal the mounting points and remove materials prone to catching fire during welding.

Find Mounting Points The Sports Car Club of America specifies at least six mounting points (see diagram, left). Weld the roll bar directly to the box frame; in unibody cars, a 36-square-inch, $\frac{1}{8}$ -inch-thick steel plate must be used as a footing.

Key Step Set the main hoop (above the driver's head) first; the rest of the cage grows from this crucial part.

DEGREE OF
DIFFICULTY



LASSO A BULL

"The actual roping of a horse, bull or 1500-pound steer is a matter of seconds—a very intense 10 seconds," says Chase Cervi, a Colorado-based rodeo pickup man (the guy who rescues riders after a fall). "The closer you can get to the steer or the horse, the better," Cervi says. "Aim for the head. Pull the slack of the rope quickly to secure it around the animal's neck. Keep your upper body square and up over the saddle horn. This puts you in a good position to dally. It all happens fast, and you've got to slide the rope so that you don't choke the animal."

GLOSSARY

Dally: Cowboys connect the lassoed animal to the saddle by wrapping the rope counterclockwise around the saddle's front horn.

Roping Saddle: A heavy, sturdy saddle with a thick, large horn used to control a dallied animal. The saddle has a low rear cantle and a slick fork, or seat. Both allow a quick dismount.





SUPER

SHE

BUILDER: Mike Christie-Fogg **LOCATION:** Colchester, Conn. **SQUARE FOOTAGE:** 250

WHY THE SHED IS SUPER: Visually stunning, agriculturally functional, made from salvaged materials and popular with the neighbors' goats, Christie-Fogg's greenhouse and potting shed prove that one man's trash can become another's treasure.

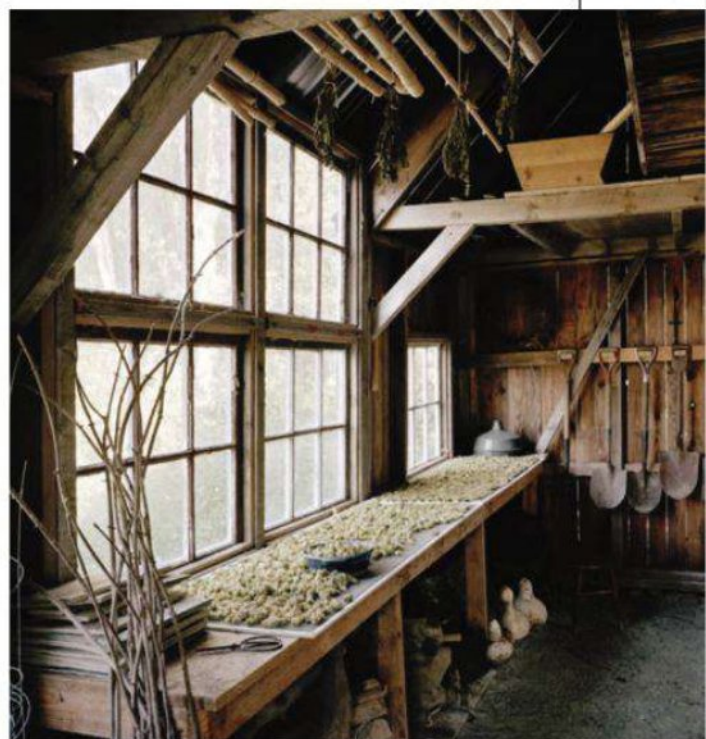


A

musty hole to hold the mower. A cluttered cubby for a derelict dirt bike. A dank hovel hiding rusty lawn chairs. We call such modest structures sheds, whether they're prefab plastic bubbles or precut plywood boxes. But it's okay to expect more from a shed—a lot more. Here, we highlight prime examples of new, aspirational out-buildings that put ready-made shacks to shame. These super sheds are the homes of the blacksmiths, bike clubs, gardeners, brewers and builders with projects too dear to take place in any old hutch.

DS

BY AMANDA DEMATTO



Heart of the Garden

Hops for home-brewed beer dry in the New England shed Mike Christie-Fogg built from discarded materials he found on job sites and roadsides. "I'm a pack rat for recycled materials," he says. "I'm trying to tone it down so I don't have big piles of garbage lying around."

While remodeling a 1940s Ford dealership near his home in Connecticut, woodworker Mike Christie-Fogg hit the lumber jackpot. "These big beams, rafters and solid $\frac{3}{4}$ -inch pine flooring had to come out. It was a couple thousand square feet, and they were going to trash it." Christie-Fogg helped himself to the clean, old-growth wood. "I could have made furniture out of it, but then I thought, I have enough to make an entire *barn*."

The plan came together after he drove his Toyota Corolla past a pile of antique windows put out as garbage. He returned with his truck, loaded up the glass and went home to create an 18 x 10-foot barn with a 10 x 7 greenhouse.

Now, he germinates seedlings there in spring, and in summer, tomatoes ripen among rows of shovels. In fall, he starts onions, kale, broccoli and beets in the barn, then moves the plants to a heated nursery. He also dries the hops he uses to brew a dark Dunkelweizen. "There are some beautiful barns in Connecticut," he says. "I always wanted one."

PHOTOGRAPHS BY MATTHEW MONTEITH

Hilltop Paradise

BUILDER: Jeffrey Tohl

LOCATION: Studio City, Calif.

SQUARE FOOTAGE: 65

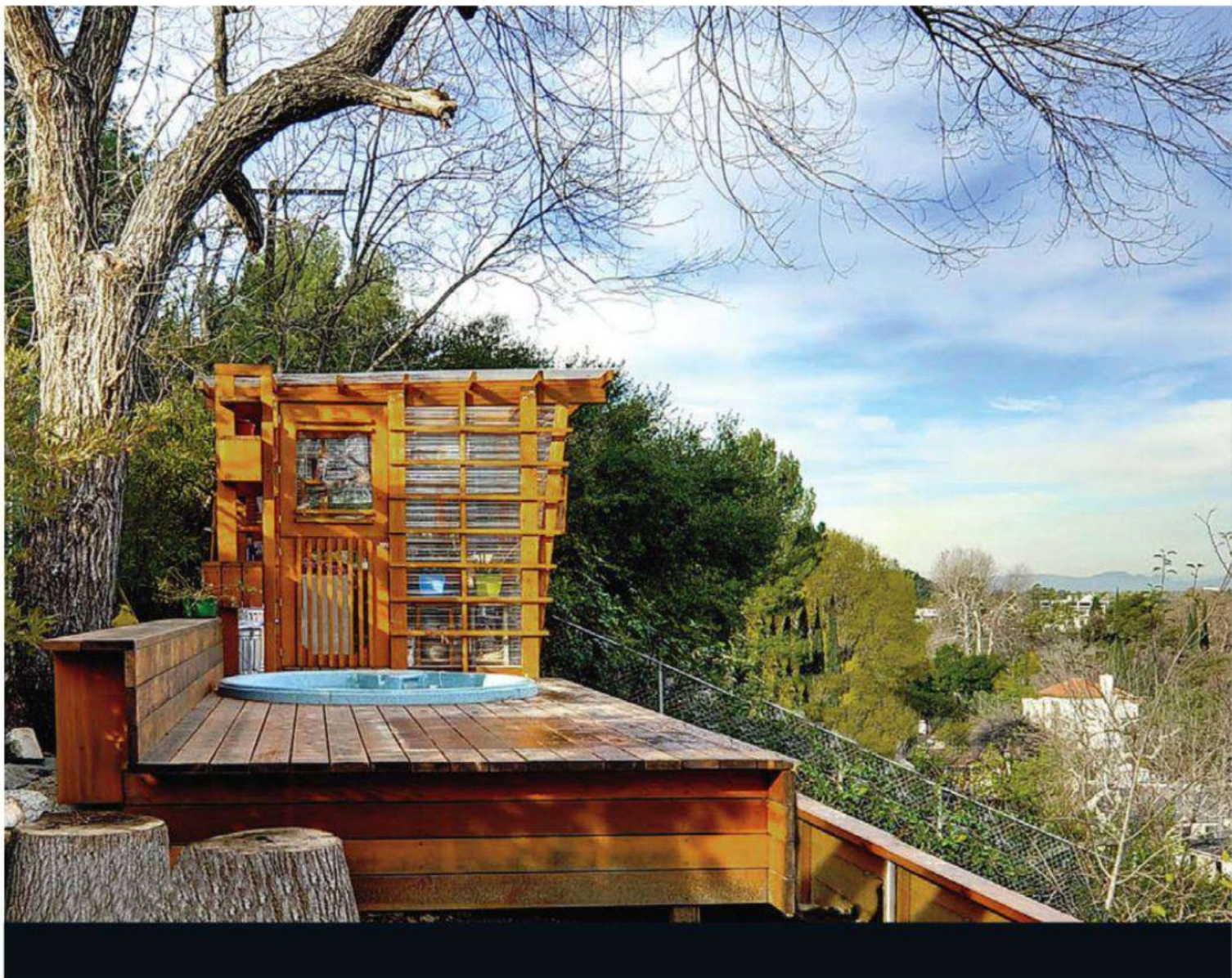
WHY THE SHED IS SUPER: Though it has some luxurious appointments, such as a hot tub in the deck, the shed stays humble with its modest scale and low-cost, practical materials, like corrugated plastic panels and stock redwood lumber.



Jeffrey Tohl graded his steep hillside lot in Studio City, Calif., into a cascade of terraces connected by footpaths and stairs. From the courtyard behind his house, Tohl ascends to a vegetable garden and orchard with peach, lemon and pomegranate trees. Even higher—61 feet above the sidewalk—sits a redwood greenhouse anchored by 4 x 6

PHOTOGRAPHS BY VAL RIOLO

As a gift for his wife, architect Jeffrey Tohl built a potting shed overlooking Los Angeles and the San Gabriel Mountains.



posts set in concrete. Tohl built the super shed as a gift for his wife. "Terracing allowed us to have a variety of landscape environments," says Tohl, who's an architect by trade. "The greenhouse is secluded, rustic and private, but you have this amazing 200-degree view."

To make sure his wife could enjoy the view while tending to succulents and herbs, Tohl designed a rectangular casement window that offers a panorama of the landscape and the mountains in the distance. He added a Dutch door so the room could feel open without inviting the family dog to trample the seedlings. To hold down construction costs, Tohl stuck to inexpensive materials, such as \$11 corrugated plastic panels for the walls, and joined the crew to finish the job in just two weeks. Fast work, especially considering the shed's hilltop site: "Everything had to be carried from the street—dirt, concrete, lumber... It was a colossal undertaking."

SUPER-IZE YOUR SHED



Heat It Adding a heat source raises safety concerns and makes for more complex permitting. That said, wood stoves are a popular choice, in part because they're available in sizes to suit just about any shed. Most propane units are not rated for indoor use (check the UL listing first). Ceiling-mounted electric heaters reduce clutter.



Wire It Always specify wiring in your shed plans when applying for building permits. Codes usually require a subpanel to serve the shed's circuit breakers. From that panel, run armored wire underground (6 inches deep is typical); where it emerges from the ground, sheathe the wire in a slip coupling to allow movement but prevent abrasion.



Plumb It Or maybe not. Building departments often consider plumbing part of a habitable structure, as in a small house. A water-free composting toilet can work, but it requires installing a roof vent and running a drain line to an external tank that must be amended frequently with wood shavings and cleaned out twice a year—a dirty job.

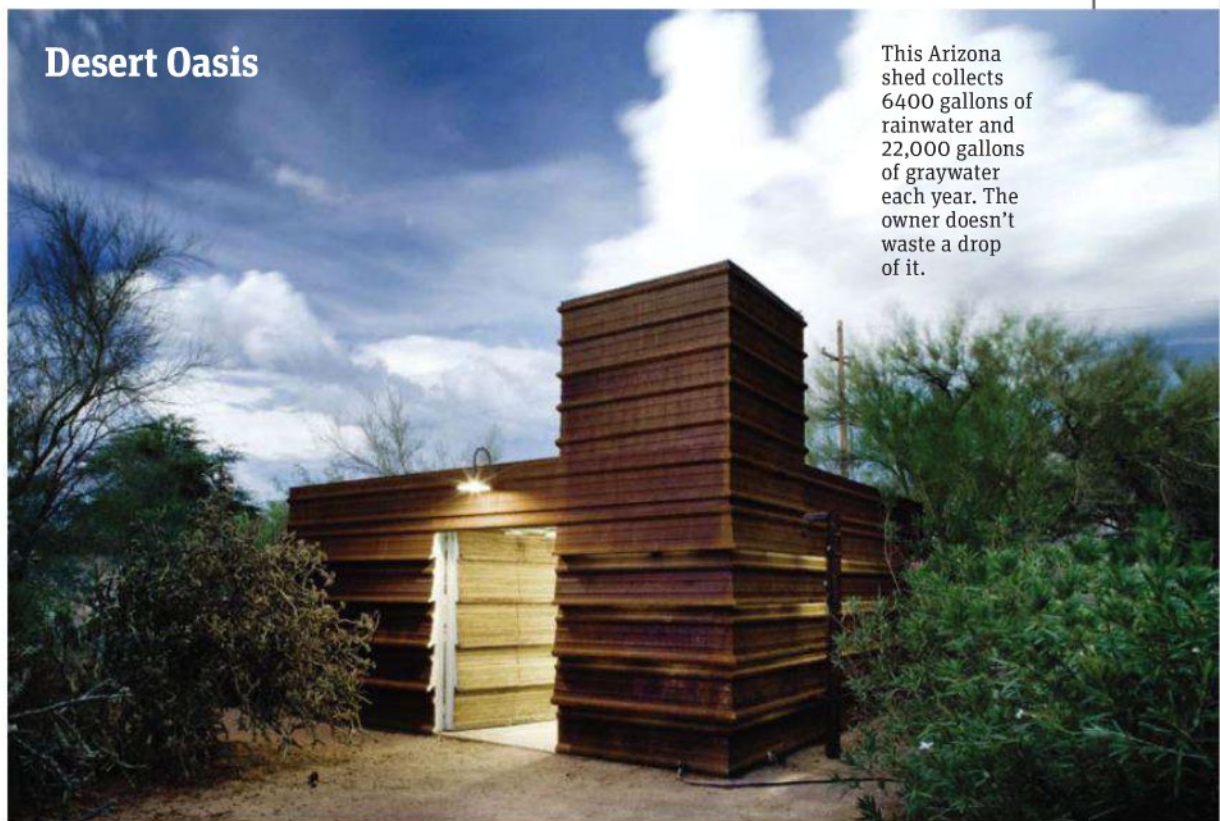


Light It Study the natural light patterns on the shed site before building, and position any windows or skylights so work surfaces receive afternoon sun. Design ceiling-hung, wall-mounted and exterior path lights along with the wiring plan.



Insulate It For multiseason shed use, retrofit stud and rafter bays with fiberglass batts, sealed under drywall or ¼-inch plywood. In a new shed, plan extruded-polystyrene subslab insulation to prevent the cold from creeping in through the floor.

Desert Oasis



This Arizona shed collects 6400 gallons of rainwater and 22,000 gallons of graywater each year. The owner doesn't waste a drop of it.

Just 12.71 inches of rain falls annually in Tucson, Ariz. To collect as much of it as possible, Ben Lepley used reclaimed lumber to build a 400-square-foot water-storage shed in his parents' yard. The structure began as a 700-gallon tank he and his brother fashioned from a discarded 4-foot-diameter steel culvert. Lepley poured a concrete bottom in the tank and rigged gutters and drains to feed into the cistern. "The tank fills to capacity when just half an inch of rain falls," he says. But while giving a drink one day to thirsty desert plants and native fruit trees, Lepley discovered that the hose ran dry while the tank was still half full. He solved the problem (and gained 900 gallons of capacity) by adding a sump pump and a second tank, using gravity to increase the system's water pressure. He also expanded the liquid-collection network to draw in graywater from the showers and washing machine. "All the water gets pumped up to the water tower, and then it's ready to use around the yard," Lepley says. Switches inside a vertical gutter pipe automatically shut off the pump to avoid overflow, and a homemade depth gauge, made from a buoy, shows the quantity left in the tank.

Blacksmith's Barn



BUILDER: Mark Suchocki

LOCATION: Royalston, Mass.

SQUARE FOOTAGE: 576

WHY THE SHED IS SUPER: At Suchocki's Black Dog Forge, hammering a 2000-degree F iron bar on a 289-pound anvil is a typical day in the shed.

"The feeling you get from taking a piece of steel, heating it and then forming it at will is just indescribable," Mark Suchocki says.



E

ver since Mark Suchocki built his first coal forge, in 1999, he's been hooked on blacksmithing. "The first winter, I'd go through knee-deep snow to get to the forge," he says.

The forge sat for a year behind his house in northern Massachusetts. But after a subzero day froze the water in his slack tub, he decided enough was enough—and in the fall of 2000, he spent \$5000 to build a 24 x 24-foot smithy with a steel roof and dirt floor.

"You have a hot side of the shop and a cold side," he explains. The hot side holds the forge, anvils, fly press, chisels, tongs and punches; on the cold side, you'll find the storage racks, assembly table, sanding station and bar twister. Suchocki actually crafted many of the hammerheads and chisels that line the smithy's walls. "You know you're a blacksmith when you use one tool to make another," he says.

Bikes in a Box

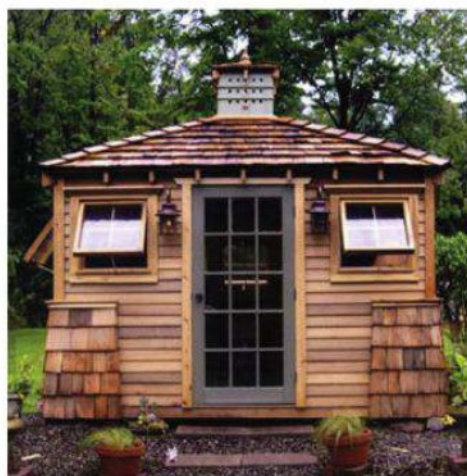
Derrick Pacheco's Phoenix bike shop proves the minimalist credo that less is more. He paid \$1700 to have an 8 x 20-foot shipping container delivered to his backyard in the summer of 2010. After he spent three months and \$4300 insulating and wiring the box, it became a bike shop, and a magnet for the city's two-wheeled community. One neighbor with a broken axle scored a wheel from Pacheco's stash for \$10. Another brought in his mom's 1948 Schwinn Hornet, brushed with blue house paint, in need of restoration. After finding the replacement parts, Pacheco repainted and revived the classic. "The old Schwinn is a head-turner," Pacheco says. "We take care of the customer for the life of the bike. Since I decided to make bikes my career, it has been everything bike—all day!"

On Pacheco's assembly line (below right): a brazing station, spare tires and power tools aplenty.



"I DON'T NEED BLUEPRINTS, I JUST KNOW HOW TO USE A HAMMER." — MICKY WEBER

No Plans, No Problem



Micky Weber built a 144-square-foot garden escape in North Collins, N.Y., working off a sketch made by his wife, Lynn. "I don't need blueprints," Weber says. He made a jig to assemble cedar-framed barn sash windows, and the couple laid a hose 200 feet across the lawn to direct water from the house into the shed through a reverse garden-hose coupler.

Lynn managed to spiff up a bargain-priced plastic utility sink from a big-box store by switching out the standard fixture with a high-neck copper faucet. "We also mounted the sink onto a cupboard," she says. "Now everyone thinks it's a porcelain sink."

Cedar siding, matching roof shingles and a purple-martin birdhouse cupola grace the exterior. "When we built it, over the summer of 2007, a lot of people stopped to see what the heck we were doing," Lynn says. "The day we moved it into place, people were driving by, honking, cheering and yelling, 'It looks good!'" **PM**

The Webers' homemade barn sash windows have leather-lace fasteners; an open cupboard adds a built-in look to the gardener's utility sink.

4

G



AN EARLY ADOPTER'S GUIDE

by Seth Porges
photograph by Dan Saelinger

POPULARMECHANICS.COM | APRIL 2011

85

Today's Netflix-streaming, videoconferencing, Angry Bird—tossing smartphones have an almost insatiable appetite for data. These devices don't just sip bits, they gulp them down in a movable feast of apps, video and Web browsing.

But all that data has a downside: Surfing the once-wide-open 3G freeways can now seem like slogging through rush-hour gridlock. At times, even basic tasks on a smartphone can bring you back to the dial-up days, when Web pages took minutes to load.

Enter 4G. With promises of cable-modem-like speeds, these next-gen networks could change the way we use mobile devices. The first 4G networks are up and running now, but is it time to sign the two-year contract?

REAL-WORLD TORTURE TEST

When it comes to the 4G future, speedy Web browsing is just the beginning. To see how the carriers' new networks handle higher-performance tasks, PM editors Glenn Derene and Seth Porges put the networks through a battery of tests designed to push them to their limits—and beyond.



So What Is 4G?



First, a bit of history: 3G has been available in the United States since 2003. These networks came in a jumble of competing standards (EVDO, HSPA) from carriers such as Verizon, Sprint and AT&T, offering download speeds ranging from 300 Kbps to 1.5 Mbps and turning phones into true data devices. The first 4G network in the U.S. rolled out in select cities in 2008, and 4G gained serious momentum last fall as more networks came online.

As you might expect, the higher the Gs, the greater the speed. (Those Gs, by the way, stand for "generation," as in "third generation," "fourth generation," etc.) But that doesn't mean there's a standard defi-

nition of what constitutes a 4G network. Like "natural flavoring" and "new and improved," the 4G label is as much marketing as technology. "What defines 4G is a matter of opinion," says Roger Marks, chair of the IEEE broadband wireless working group. "There is no formal authority that decides what 4G is."

As a result, the carriers have resorted again to a variety of different—and completely incompatible—technologies, all stamped with the 4G label.

Semantics aside, users can expect to get a substantial speed boost by switching to 4G. In recent testing, we found the 4G networks able to achieve real-world speeds ranging from 5.8 Mbps on T-Mobile all the way to 24.3 Mbps on Verizon.

How Does It Work?



Like 3G before it, 4G offers up an alphabet salad of standards: Verizon is using LTE (Long Term Evolution); Sprint, in partnership with Clearwire, is behind WiMAX (Worldwide Interoperability for Microwave Access); T-Mobile is using HSPA+ (a beefed-up version of the current 3G High Speed Packet Access standard); and AT&T is offering a combination of LTE and HSPA+.

Each technology has its advantages. Verizon's and AT&T's LTE signals live primarily around the 700-MHz band, once used for analog TV broadcast. These

HD VIDEO TEST

To evaluate how 4G handles video, we used a Sprint mobile hotspot to stream Netflix to an Xbox 360. The result was stunning HD video—at first. After a few minutes, Netflix bumped us down to standard def (interrupting our movie). Minutes later, it was back up to HD, and then down again. Seems like 4G isn't yet ready for home-theater heavy lifting.



THREE-CITY
LAB TEST

relatively low-frequency signals can travel long distances and reach deep into buildings, meaning LTE devices should get a stronger signal in places such as basements and elevators.

The WiMAX network run by Sprint and Clearwire operates in the higher-frequency 2.5-to-2.7-GHz band. According to the IEEE's Marks, WiMAX antennas should be able to handle more data traffic; this extra capacity should help avoid the sort of network overload that often chokes up and slows down today's 3G networks.

HSPA+ networks offer less potential bandwidth than WiMAX or LTE, but they are easier to deploy. Because HSPA+ is essentially an upgrade to existing infrastructure, AT&T and T-Mobile can initially offer a far larger footprint than the select cities and airports WiMAX and LTE cover.

Which technology will prove best? It depends on how 4G evolves. LTE is the fastest now, but that may not matter if it gets overcrowded with data-hogging users. And if plans to expand the footprint of LTE and WiMAX stall, the slower HSPA+ networks may come to seem like a smarter bet.

Which Gadgets Use 4G?



So far, there are three basic types of 4G devices: smartphones, USB modems and mobile hotspots that harness 4G service

to create portable Wi-Fi networks for multiple devices. (Mac users, watch out: Some of the USB modems we tested are Windows-only—check before you buy.) None of these devices can replace a home Internet connection yet (see "Home Router Test"), but our tests showed 4G speeds to be, at their best, good enough to tackle most high-bandwidth tasks, including streaming video from a variety of sources, such as Netflix, Hulu and YouTube.

There are also a number of laptops and tablets with 4G access built in. Although they may seem less expensive than a Wi-Fi-only version of the same device, they typically require users to sign a multiyear contract, which can add up to thousands of dollars. And unlike a USB modem or mobile hotspot, their connections cannot be shared by multiple devices.

Since 4G network coverage can be limited, most 4G devices have the ability to fall back on a slower 3G network. This safety net isn't just useful for people who find themselves outside of cities covered by 4G—even in 4G service areas, we found that devices frequently lost the speedier connection and got bumped down to 3G.

The 4G networks are power hogs that can strain a phone's battery. "As 4G chipsets mature and we see more multicore devices, battery life should improve," says Ross Rubin, executive director of industry analysis at the NPD Group. Until then, many 4G phones give users the ability to switch off 4G to preserve battery life—something we found ourselves doing to get through a day between charges.



We sent 4G USB modems from three providers (no AT&T devices were available at press time) on a tour of New York, Chicago and San Francisco. In each location, we performed tests at different times of day, checking upload and download speeds. In our New York lab, we also ran the pivotal how-long-does-it-take-to-connect test. We found that both provider and location matter quite a bit.

HOME ROUTER TEST

Can a 4G network really replace a home wireless router? To find out, we sicced a houseful of Wi-Fi gear on a mobile hotspot running Sprint's 4G WiMAX network. Our test gear included a Netflix-streaming TV, two video-streaming computers (one playing YouTube, the other handling Hulu) and a Web-surfing iPad. On their own, each of these devices worked, at least intermittently. But when used all at once, Netflix skipped down from HD, Hulu lowered its frame rate to once every few seconds and YouTube slowed to a crawl. Bottom line: We'll be keeping our cable—at least for now.



THE PLANS

→	VERIZON	×	T-MOBILE	×	SPRINT/CLEARWIRE
SPEED (megabits per second)	New York Download: 14.2 (avg.); 19.0 (max.) Upload: 5.8 (avg.); 6.5 (max.) Chicago Download: 20.1 (avg.); 24.3 (max.) Upload: 8.8 (avg.); 13.3 (max.) San Francisco Download: 16.7 (avg.); 22.5 (max.) Upload: 2.4 (avg.); 2.5 (max.)		New York Download: 2.4 (avg.); 3.4 (max.) Upload: 1.2 (avg.); 1.6 (max.) Chicago Download: 1.9 (avg.); 2.2 (max.) Upload: 0.5 (avg.); 0.5 (max.) San Francisco Download: 4.0 (avg.); 5.8 (max.) Upload: 1.1 (avg.); 1.4 (max.)		New York Download: 4.7 (avg.); 5.6 (max.) Upload: 1.2 (avg.); 1.8 (max.) Chicago Download: 4.6 (avg.); 8.8 (max.) Upload: 0.8 (avg.); 1.2 (max.) San Francisco Download: 1.5 (avg.); 3.8 (max.) Upload: 1.3 (avg.); 1.6 (max.)
MONTHLY PRICING	Phone No pricing at press time Modem \$50 (5 GB); \$80 (10 GB)		Phone \$50 (unlimited data) Modem \$25 (200 MB); \$40 (5 GB)		Phone \$30 (unlimited data) Modem \$50 (unlimited data)
AVERAGE LOG-ON TIME	15 seconds		11 seconds		18 seconds
COVERAGE AS OF FEBRUARY 2011	38 markets		100 markets		71 markets

Bottom Line

Sexy devices and fast networks are great—if you can stomach the monthly bill. And the cost of 4G can sneak up on you. Only Sprint and Clearwire currently offer blanket unlimited data plans, beginning at \$30 per month. (T-Mobile offers a \$50 unlimited 4G data plan for phones, but it

does not cover USB modems.) Verizon's LTE plans are capped at 5 GB per month for \$50 or 10 GB for \$80. (AT&T had not announced 4G pricing as of press time.)

Zooming past a data cap can cause fees to add up quickly. While T-Mobile's \$40 for 5 GB plan has no overage fees (instead, the company warns that heavy users may face a reduction in data speed), Verizon charges \$10 per gigabyte over its data caps. And the high speeds of 4G put those caps within surprisingly easy reach: Just 3 hours of HD Netflix streaming will get you to the 5 GB monthly limit.

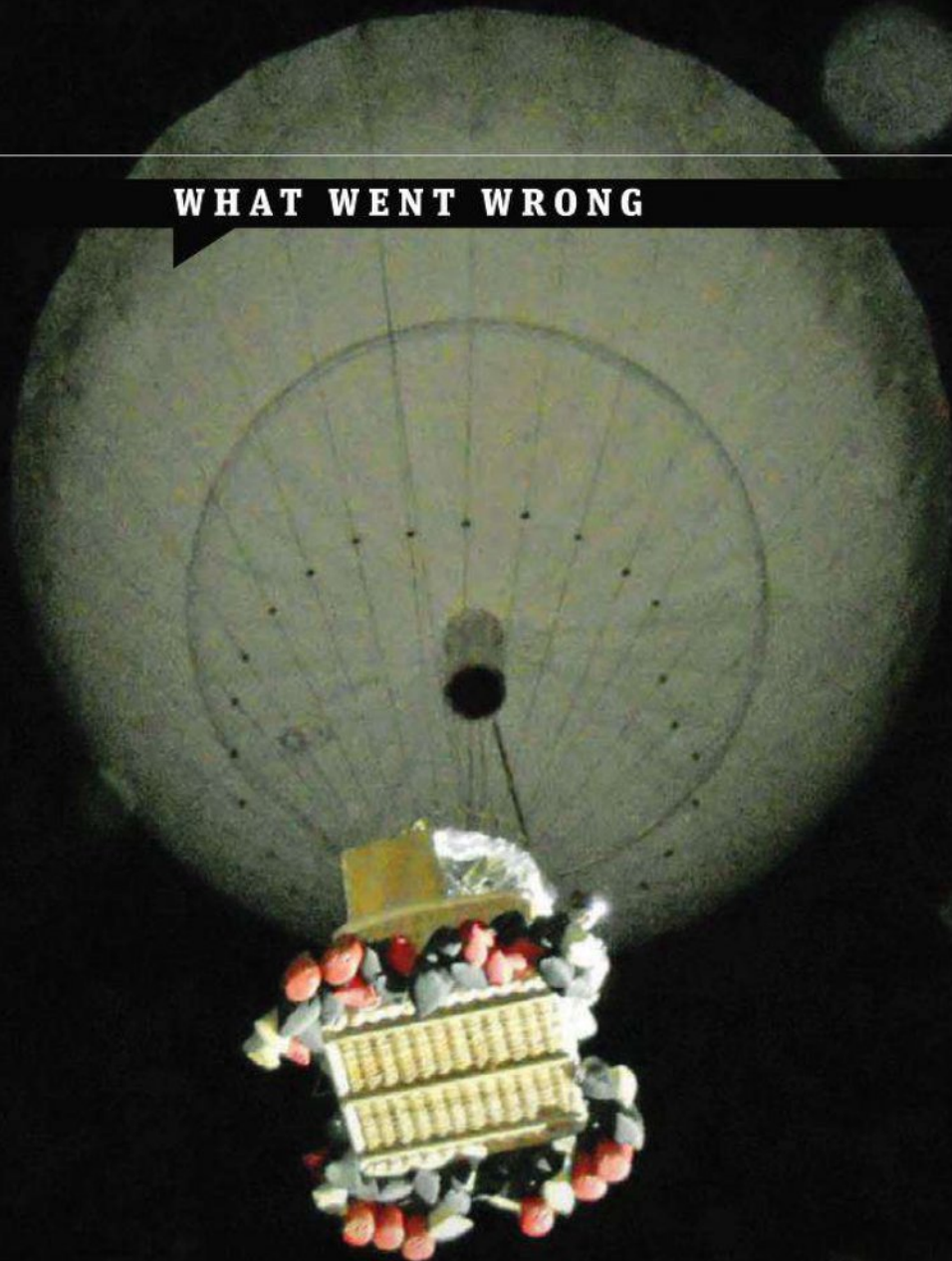
The drawbacks of 4G are many—limited equipment, spotty coverage, confusing plans—but temporary. At this early stage, it's impossible to pick the best network. Yet 4G networks do offer one huge benefit to early adopters: Because these networks are new, they are still running under capacity. If you're lucky enough to live in an area with coverage, using a 4G device today is like driving a Lamborghini on a new highway with light traffic. And that may not last. If the history of 3G has taught us anything, it's that when carriers build capacity, users will come. **PM**

TRAIN-COMMUTER TEST

Whip-fast 4G networks should be a commuter's dream. But how do the networks handle a laptop roaring along at 60 mph in a train traveling from New York City to Connecticut? We found that all three services we tested (Verizon, Clearwire and T-Mobile) lost their grip on a 4G signal long before the Connecticut border, which is 30 miles from midtown Manhattan. Despite coverage maps that show strong 4G signals along all or most of the route, the USB modems from all three carriers routinely reverted back to slower 3G connections as we sped away from the city center. Halfway through the Bronx, 4G signals started dropping like flies. Clearwire's WiMAX service, in particular, proved to be as slippery as a greased watermelon—every time we lost a signal from one tower, it took 15 to 25 seconds to try to find and lock on to another 4G connection.



WHAT WENT WRONG



THE DISAPPEARANCE OF USA-2

BY JEFF WISE

Richard Abruzzo and Carol Rymer Davis ascend in USA-2 at the start of the world's most prestigious balloon race. It was the last time they were seen alive.

LAUNCH SITE: BRISTOL, ENGLAND
EVENT: GORDON BENNETT CUP
DATES: SEPTEMBER 25-29, 2010

Gas Racing Balloon

- Built for extended trips, the hydrogen gas balloons used by racers in the Gordon Bennett Cup share features that maximize control and minimize risks.

SAFETY EQUIPMENT

Transponder: Transmits altitude and speed.

Communication: Two VHF radios, satellite phone.

Emergency transmitter: A locating signal that is triggered manually or on contact with water; it failed to activate on USA-2.

Life rafts: A two-person raft with marine survival suits.

APPENDIX

Relieves pressure as the 35,000 cubic feet of gas expand with the heat of the day.

BASKET

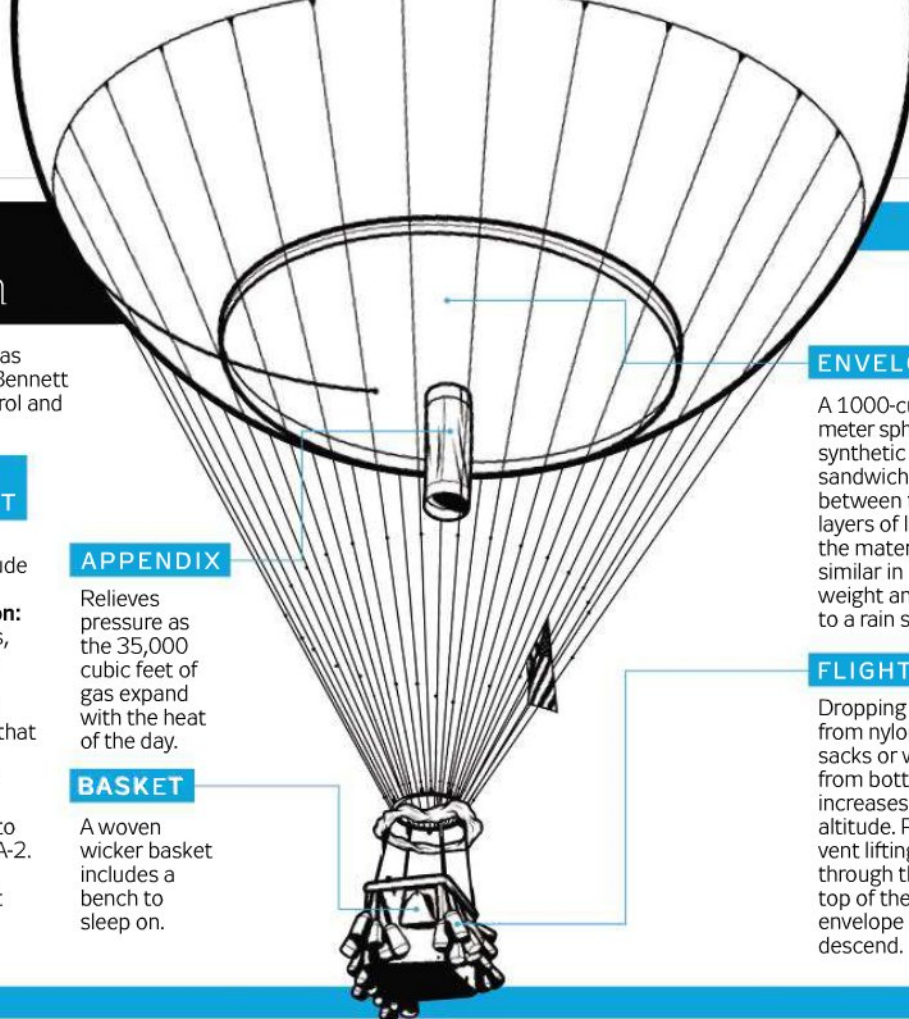
A woven wicker basket includes a bench to sleep on.

ENVELOPE

A 1000-cubic-meter sphere of synthetic fabric sandwiched between two layers of linen; the material is similar in weight and feel to a rain slicker.

FLIGHT BAGS

Dropping sand from nylon sacks or water from bottles increases altitude. Pilots vent lifting gas through the top of the envelope to descend.



L

LAST SEPTEMBER, AS THE SUN SET over the English city of Bristol, 20 giant jellyfish shapes shivered into the sky, one by one. Their loose skins quivered and swayed in the pale rosy light, swelling as they filled with hydrogen gas into taut, five-

story-high spheres. The start of the Gordon Bennett Cup balloon race was drawing near.

For American balloonists Richard Abruzzo, 47, and Carol Rymer Davis, 65, the evening was becoming tense. The weather was colder than expected; Abruzzo had to roam the competition site trying to find someone who would loan him a down jacket. Then, as the ground crew moved their balloon to the launch area, he and Rymer Davis realized the system that charged their communication and navigation gear had a faulty port. By the time they fixed it and powered their equipment, the pair and their balloon—designated USA-2 by race officials—had missed their scheduled departure slot.

At last, at 11:29 pm, all was ready. Well-wishers and crew members pressed around the basket as “The Star-Spangled Banner” played on a loudspeaker. Members of the ground crew pulled away sandbags holding the balloon to the ground, and Abruzzo and Rymer Davis rose into the darkness, until all the onlookers could see was the rectangular bottom of the dangling wicker basket. In a few more seconds, that tiny shape disappeared as well.

For the next four days, Abruzzo and Rymer Davis drifted more than 1000 miles, first south over France, then east over

the Mediterranean and across Italy. The pair maneuvered to find optimum air currents, jockeying from 18th place to sixth. And then, with the race nearing its climax, USA-2 vanished.

INAUGURATED IN 1906, the Gordon Bennett Cup is the oldest and most prestigious event in ballooning aviation. The goal is straightforward—land as far as possible from the launch site. To do so, competitors search for the strongest winds by using the only two control mechanisms at their disposal: dumping sand and water to increase altitude, and venting gas to descend. The team that manages these finite resources most skillfully travels farthest and takes home the cup.

But drifting with the wind in a wicker basket thousands of feet above the ground makes gas-balloon racing one of the most dangerous sports. The greatest natural hazards are thunderstorms, which pose multiple dangers that can destroy a balloon—severe downdrafts, updrafts, wind shear, hail and lightning. During the running of the race in 1923, three balloons were struck by lightning, killing five of the six crew members.

The 2010 race offered a new, man-made hazard: land mines. The day of the race, officials announced that the Balkans, which had previously been off-limits for competitors, would now be open to flyovers and landings. The only hitch: An estimated



Rymer Davis and Abruzzo just before takeoff at the 2010 Gordon Bennett Cup. The ring of plastic unfurls to block rain.

1 million active land mines are scattered around the region. For a balloonist touching down beneath 35,000 cubic feet of hydrogen gas, the race could end in a truly dramatic explosion.

This perilous, highly technical and expensive sport has produced a small community that is at once intensely competitive and tightly knit. Everyone in it must possess not only the money to field a balloon and a ground crew, but also the willingness to take on potentially fatal risks.

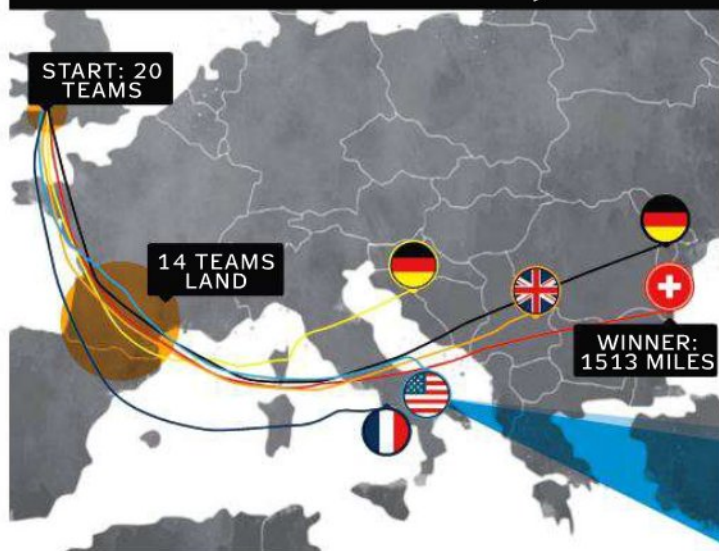
Richard Abruzzo lived in the center of this world his entire life. His father, Ben, was a legend, having been a member of teams that made the first balloon crossings of the Atlantic and the Pacific. Richard carried on the family tradition, breaking his father's endurance record in 1992 by flying from Maine to Morocco.

Rymer Davis, a Denver radiologist and a former champion skier, started ballooning in the 1970s, when Americans were first adopting the sport. She competed against the elder Abruzzo in the 1980s and shared his driven personality. "Everything she did, she did better than anyone else," says Kathie Leyendecker, Rymer Davis's friend.

During the 2005 Gordon Bennett Cup, Richard Abruzzo and Rymer Davis were gliding over Kansas when their balloon caught a downdraft and hit a power line. Abruzzo fell 40 feet to the ground, shattering his wrist and fracturing his ribs and pelvis. Without his weight, the balloon soared to 14,000 feet before Rymer Davis brought it under control.

The accident didn't dull the pair's ardor for the race. "It's like the America's Cup," says Vermont-based balloon-maker Brian Boland. "To compete, you really have to go for broke."

A Slow Race Turns Deadly



SEPT. 25, 2010: 11:36 PM

After the final launch from Bristol, 20 balloons drift south at about 20 mph and climb to about 6000 feet. Pilots change speed and direction by ascending or descending to catch air currents. By the time the racers reach southern France, all but six teams—two from Germany and one each from France, the U.S., the U.K. and Switzerland—have landed instead of braving the Mediterranean. The French balloon drops out in Italy; the others cross the Adriatic, with the Swiss traveling farthest. The Americans, however, get into trouble over water.

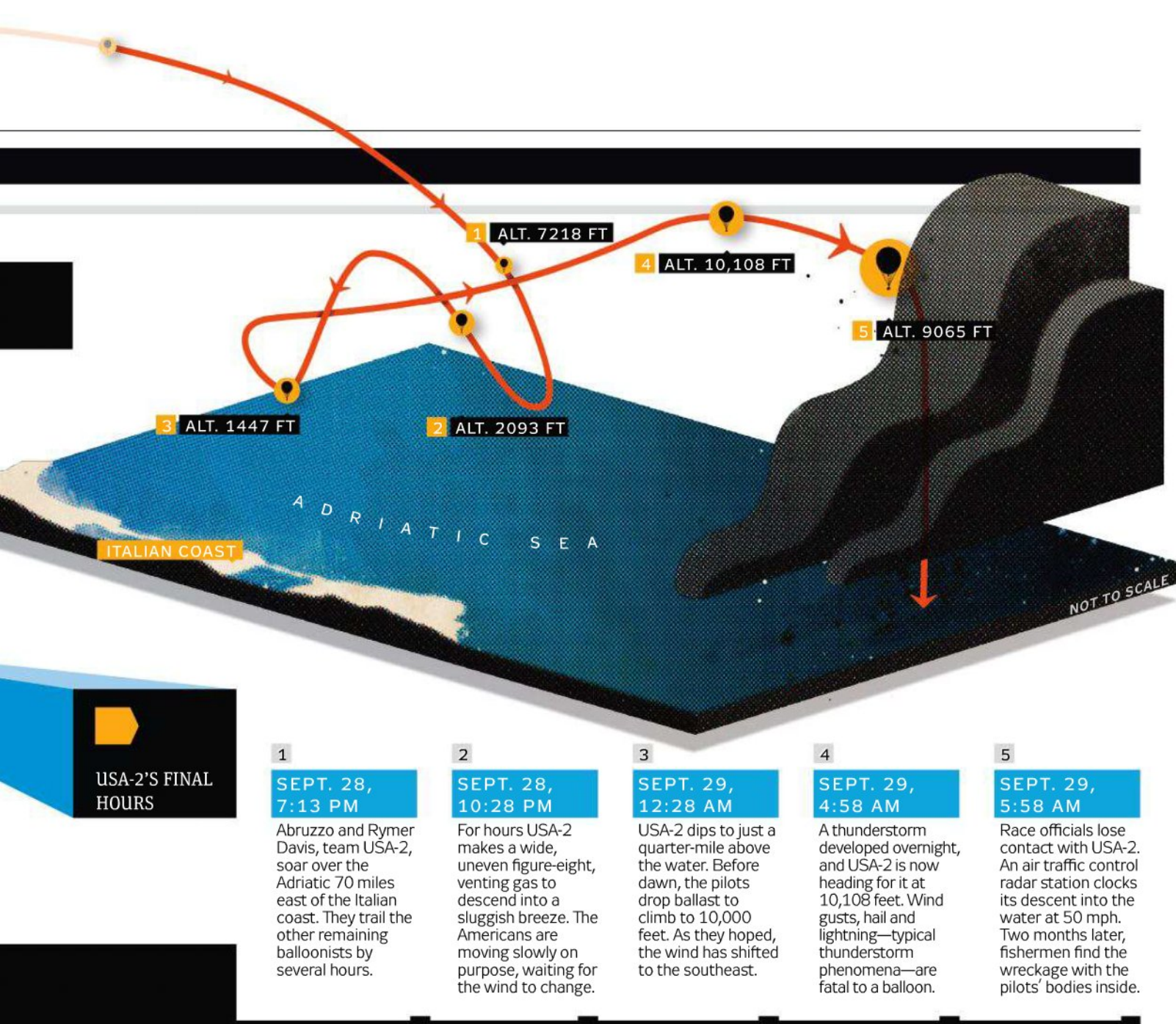
AT THE START OF DAY FOUR, only six balloons were still in the air. Just after 7 am, the French set down in southern Italy. The British, two German teams and the Swiss all rode powerful easterly winds at an altitude of about 10,000 feet across the Adriatic Sea. In the early afternoon, one of the German teams landed in Croatia; the other balloons kept heading east. The Americans, however, chose a different strategy.

At about 10:30 pm, Abruzzo and Rymer Davis dropped to 2093 feet above the water, where they waited for winds that would carry them southeast into Albania. The move would maximize their distance but increase their time over water. "They were playing a very clever game," says David Hempleman-Adams, who was in the British balloon.

Soon after midnight, USA-2, now just 1400 feet above the water, shed ballast to ascend. By 4:30 am, it had reached 10,000 feet. Then the wind began shifting to the southeast. Albania was in the team's sights. The gamble was paying off.

But the dawn light revealed impending trouble—the weather had changed unexpectedly, and thunderclouds were massing around USA-2. An automatic position recorder

PHOTOGRAPHS BY NICK DONNER/BALLOON PONG (PREVIOUS SPREAD); AP/WIDE WORLD PHOTOS



aboard the balloon registered an altitude of 9065 feet at 5:58 am, with a southerly heading at 9 mph. It was the final transmission. Minutes later, Croatian air traffic control radar detected the craft plummeting at 50 mph. Then, silence.

The balloon was equipped with a life raft and emergency communication equipment, but the Italian Coast Guard didn't pick up any voice communication or signals from the balloon's emergency transponder. Even in the absence of physical evidence, it gradually became clear that the team could not have survived. After five days, the Italian authorities called off the search. Hundreds mourned at memorial services held for Abruzzo in New Mexico and for Rymer Davis in Colorado. "Richard and Carol were very competitive people," says Pennsylvania-based balloon-maker Albert Padelt. "And that was one reason why they were so well-liked."

On Dec. 6, an Italian fishing trawler pulled up the missing balloon and gondola, with the two pilots' bodies still inside

the broken basket. The National Transportation Safety Board investigation is ongoing, but experts say the balloon's condition makes it unlikely that lightning caused the crash. "If it had been struck by lightning, there wouldn't have been a lot of the envelope left," says Don Edwards, event director at the Albuquerque International Balloon Fiesta, who studied photos of the wreckage. "The balloon looked intact, so it was likely turbulence."

Don Cameron, flight director of the 2010 Gordon Bennett Cup, says that in the heat of competition, balloonists may push the boundaries of what's safe: "There can be a temptation to go outside the limitations to try harder to win."

Of course, that willingness to accept risk is at the heart of gas balloon racing. This time, it cost the sport two of its most accomplished pilots. **PM**

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Home

Sod Busters

THE GRASS BELOW A HORSE FENCE PROVES THE FINAL CHALLENGE AS SIX STRING TRIMMERS FIGHT TO THE FINISH. BY ROY BERENDSOHN

→ Even after two and a half days spent comparing six heavy-duty string trimmers at the edges of trails, barns, outbuildings and stone walls, no victor had emerged. So I started them all and began cross-testing them, one at a time, along hundreds of yards of horse fence. When a machine started to vibrate or its cutting effectiveness declined as I leaned into the thick grass and weeds beneath the bottom rail, I turned it off. Rounding a bend with the last two trimmers, I closed in on an overgrown drainage ditch. Scything into it, one trimmer whispered a hint of vibration and fatigue. The other did not. Of course, not everyone has a horse farm to keep up, but whether you need a tough trimmer or simply like solid equipment, read on to find the best machine to help you maintain your property.



INSIDE

× SPRING SPRUCE-UP + MAKE A CAMP STOVE + PLUMBING PROBLEMS

PM DIY HOME ///
STRING TRIMMERS



Best
Overall



ECHO
SRM-225i



HITACHI
CG22EASSLP



All of the trimmers proved to be tough and capable. Still, the Echo excelled in tough cutting conditions.

The Echo began the test with some vibration, but it settled in nicely and ran smoothly, cutting with nearly explosive power and torque. As its performance improved, we just drove it harder and harder until it outran everything else along the horse fence. Add other features such as a robust skidplate and excellent service access points, and this is a machine at home where the tall grass grows.

Dislikes: We didn't have trouble with the gap between the bevel gear and the line head, but it looks vulnerable. Also, we think the Echo deserves a momentary stop switch (one that flips back automatically to run position). Instead, it has a sliding switch with two fixed positions that you have to double-check every time you start the machine.

We were reluctant to include the Hitachi because, as its price indicates, it's not as beefy as the other products, most of which are sold through outdoor-power-equipment dealers rather than home centers. So we were pleased to find it holding its own and cutting with enthusiasm. Its line head and bevel gear are connected without gaps, its trigger is nice and wide, and the skidplate under its gas tank is like something off a machine that's twice as expensive.

Dislikes: We appreciate this machine's tool-free access to the air filter, but the filter itself is nothing more than a small foam ring that looks inadequate for the dirty atmosphere a string trimmer runs in.

● Test Results

PRICE	\$250	\$190	
WEIGHT (FUELED)	14 POUNDS	10 POUNDS	
DECIBELS (A-WEIGHTED)	107	108	
ENGINE SIZE (CC)	21.2	21.1	



HUSQVARNA
223L



The Husqvarna was the most consistently well-mannered machine in the test. The Echo edged it out by just a hair, and that was only at the bitter end. The Husqvarna started easily right out of the box, cut aggressively and ran with almost no vibration. Along with the Stihl, it has the best-shielded cables and wires. The joint between the line head and the bevel gear is seamless, allowing no possibility of weed winding or dirt infiltration.

Dislikes: *We prefer a skidplate, not ribs, beneath the gas tank and engine housing. We also think this machine needs a more robust air filter, one with greater surface area for better dirt trapping and durability.*



KAWASAKI
KTF27B



The Kawasaki ran at or near the front of the pack for the test's duration, slicing capably through grass, weeds and brambles along the way. It started with a single pull, cut with minimal vibration and had all the features that we came to appreciate throughout the test—a big air filter and a robust skidplate below the gas tank that protects it from abrasion on the ground or garage shelf. Finally, it's got a nice big throttle lever that's comfortable during long trimming sessions.

Dislikes: *Better wire shielding near the engine is called for, as is a simpler design for the line knife, which was rugged but prone to clogging from dried debris.*



REDMAX
TR2350S



"Light," "agile" and "fierce" are the three words that best describe the RedMax. It was the only trimmer to come from the factory with a stiff, noise-reducing trimmer line—you've seen this stuff; it looks like twisted red licorice. The line is more than enough for grass and took a fearsome bite out of the brush we cut through, even taking down small seedlings along the way.

Dislikes: *We have three minor complaints with this otherwise fine machine. It has a clumsy upside-down purge bulb. Instead of a skidplate, it has two undersize bumpers below the gas tank, and the gap between the line head and the bevel gear permits weed winding.*



STIHL
FS 56 RC-E



From its three-position choke lever to its completely encased engine to its Easy Start gentle-pull recoil start, the Stihl represents careful, fastidious engineering. Yet an iron fist lurks in that velvet glove. Its cut is vicious, rivaling the Echo's. We laced into a blackberry bramble with this trimmer and sent the thorny stalks flying.

Dislikes: *Vibration. The Stihl began the test with a fair amount of it (not unusual in handheld outdoor power equipment before the parts wear in). Yet no reduction in vibration was noted by the end of the test; otherwise, this would have been a five-star machine.*

\$250

10 POUNDS

109

24.5

\$280

12 POUNDS

106

26.3

\$260

10 POUNDS

108

21.7

\$260

13 POUNDS

109

27.2

Q

Jump-Starting Spring

Every spring, my gardens look terrible and the lawn comes up patchy, with green tufts and shaggy sections. I read your article last year on making a house look good over the winter, but you should have gone all the way through to spring. Can you pick up where you left off last fall?



A quick way to add color to the muted spring landscape is with some cold-tolerant flowers, such as pansies. Fluff up mulch with a rake, or spread new material.

A Sure thing. There are two problem seasons for many homeowners: fall and spring. Of the two, I think spring is the tougher challenge, frankly. In many parts of the country, the lawn has the uneven appearance that you describe, plus it's been matted down by snow or winter rain. Perhaps it's been damaged around the edges by de-icer chemicals such as rock salt spread along driveways and walks. Then there are twigs, sticks and leaves all over the place and deer damage to your plants, and everything looks kind of bedraggled.

Before you break out the shovels, rakes and leaf blower, take a walk around and look things over. I break down the process into gardens and lawn work, small repairs and cleaning.

The easiest way to jump-start spring is to first spruce up the flower beds and put down some cold-weather-tolerant flowers. Pansies are a good choice almost any-

where in the United States.

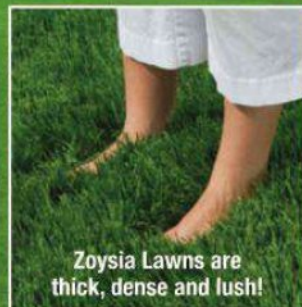
Next, get your mower running and use it to even out the grass. While many homeowners rely on spring fertilization to reboot their lawns, university research is showing that you can probably bypass this ritual unless your lawn was severely damaged the previous summer. For the cool-season grasses that cover most of the country, fertilizer is more effective when it's applied in the fall.

If you must fertilize in the spring to

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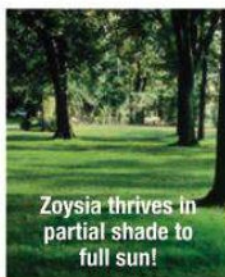
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correct lawn damage, first get a soil test done by a garden center or a cooperative extension office to find out if the lawn needs amendments such as limestone or sulfur to adjust its pH. Then wait until soil temperature reaches 50 to 55 F before you apply fertilizer. Sweep up any fertilizer that you've accidentally spread onto walks and driveways. Use a leaf blower or broom to move the particles back onto the lawn. This will keep them from being washed off pavements and into waterways.

Next, prune winter- or deer-damaged tree limbs and shrub branches. Remember when pruning to remove limbs no farther than the branch collar; don't cut flush to the trunk. The collar is the small raised ring of bark where the branch joins the trunk. It contains protective cells that will heal over the pruning cut.

With the lawn and pruning done, sweep up sand that has accumulated on your driveway and walks. Run a string trimmer along pavement to quickly clean up any rough edges. Remove leaves, twigs or wind-blown litter that has accumulated in corners.

Almost anywhere in the country, now's the perfect time to tackle small exterior repairs and other outdoor jobs, such as pressure-washing the deck, replacing weather-beaten shutters, painting the mailbox and post or installing new exterior lights. When the weather's hot and humid, you'll be glad you did some of these projects while it was cool and pleasant.

Phone Home

I travel all the time, and worry about what will happen if the battery in my thermostat goes dead while I'm away. Will that cause my furnace or air conditioner to stop working?

As a rule of thumb, most electronic thermostats will not work if their batteries go dead (except for those that have been specifically equipped with an extra low-voltage wire labeled as common). The best thing to do is to change the thermostat's batteries once a year. You can swap in fresh batteries when you replace those in your smoke detectors. There are

other steps to take. "I advise people to leave the thermostat set to heating or cooling mode, even during the months when little heating or cooling is called for," advises Pat Porzio, a Clinic contributor and HVAC manager for Russo Brothers & Co. in East Hanover, N.J. "When left in the off position, the thermostat uses battery power to maintain its settings, rather than being powered by the low-voltage transformer that serves the heating and cooling control wiring."

If you travel for long periods, consider installing a remote monitoring system such as the Sensaphone 400. It will allow you to use your phone to remotely monitor water pressure and movement inside or outside the structure. With accessories, you can also monitor and control the building's temperature, humidity and indoor and outdoor lights. Other systems allow you to open a garage door so that a friend or neighbor can get in and water the plants. Some systems also alert you if a door has been opened. And other

setups can independently operate a solenoid valve, shutting off water flow if a leak is detected. (For related information on home-surveillance systems, see "Electronic Eyes," page 115.)

Remote monitoring aside, it's always a good idea to have friends or neighbors keep an eye on your property. As good as monitoring is, you'd still need to get someone over to the house to investigate any problem to which you've been alerted. Also, a friend or neighbor can remove flyers stuck in the edge of your door and dispose of free newspapers tossed onto your driveway. Once this stuff sits around long enough to get weather-beaten, it's a dead giveaway that the home is unoccupied.

Warming Up a Refrigerator

I have a refrigerator in my garage that I'd like to use year-round. But with the temperature dropping below freezing this past winter, I was worried I might damage the fridge by allowing it to keep running in such a cold place. I'm considering installing a small heater in it—is there even such a thing?—to



SHOP WISDOM

IN PRAISE OF SCRAP WOOD

→ Hanging on the wall of my garage is a bundle of scrap wood; most of the pieces are thin strips ranging from about 1/16 inch to 1/4 inch. Some of it is plywood; some of it is pine. There are probably a few pieces of oak in there. The bundle might look like junk or kindling to somebody else, but to me it's a

nearly endless supply of thin material for a variety of tasks, like making shims or a pad to slip under the head of a clamp to keep it from marring the work surface. Most of the pieces in the bundle are so thin, I snip them

to length with a pair of shears. When the bundle gets depleted, I just saw up some more pieces.



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HOMEOWNERS CLINIC Q+A

make sure it stays within the proper temperature range.

First, ask how much you really need the appliance. Underutilized garage refrigerators are huge energy hogs. Can you replace it with a box refrigerator tucked inside the house somewhere? Depending on the kind of food you are storing, you may be able to simply turn off the refrigerator during the coldest months. Food that needs to be kept at a consistent temperature or protected from freezing will have to be moved out of the refrigerator if you go this route, of course. But that case of Pabst Blue Ribbon should be fine.

The other solution would be to move the appliance indoors. That's the most energy-efficient alternative.

As to your question, yes, there is such a thing as a refrigerator heater. Frigidaire makes one for recently built appliances (2001 or later). The heater goes into the thermostat housing and warms the thermostat slightly, forcing the compressor to stay on longer. The device is intended only for Frigidaire refrigerators, however. And the heater may not be an optimal solution. "It's a can of worms," says Chris Hall, president of Repairclinic.com, an Internet appliance-parts provider. The installation is fussy, and you have to follow the instructions carefully.

No Permit, No Good

We are in the midst of buying a house that has had many recent improvements. Our home inspection report points out that the new central air-conditioner condenser was probably installed without a permit because its disconnect lever is located behind the condenser. The condenser is close to the outside wall, but you still have plenty of room to get at the lever. It doesn't look like a problem to me. Is the inspector right?

The home inspector is probably right. Fortunately, the problem cited isn't any reason not to buy the house. It's the kind of thing that an electrician or a heating-cooling contractor can iron out in a couple of hours.

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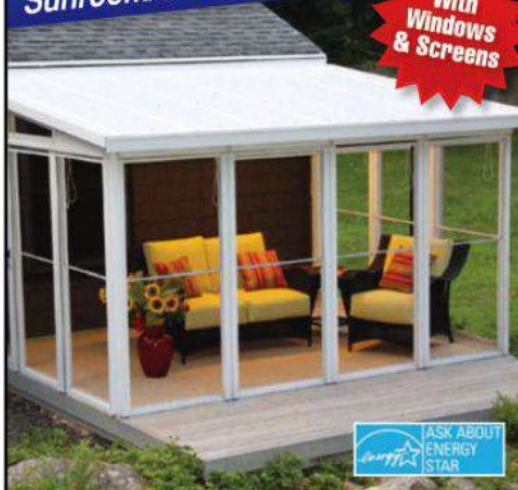
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*Varies by locale

1441POP

The National Electrical Code (NEC) requires that the disconnect be located within sight of the air conditioner's compressor/condenser (often just called the condenser). That encourages the technician to turn off power to the appliance before working on it, and it allows a quick visual check to confirm that the power has stayed off if he or she has stepped away and then returns.

The NEC also requires sufficient working space for the electrical equipment to be serviced. The condenser is considered one piece of equipment, and the disconnect switch is another. The NEC calls for a working space ranging from 30 inches to 3 or 4 feet, depending on voltage and the specifics of the situation. "You need at least as much clearance as specified by the NEC," says Harris Breit, an Arizona electrician with a half-century of experience. "Remember, the condenser is grounded. If an electrician comes in contact with the condenser and an energized wire serving the disconnect, he can get electrocuted. That's why a safe working distance is so important."

To comply with the NEC and local regulations, electricians (or heating-cooling contractors) install the disconnect well off to the side of the condenser. I'd call an electrician and a heating-cooling contractor and request a thorough inspection of the system.

Good Plumbing Gone Bad
I've got a two-handle tub/shower in an upstairs bathroom with 30-year-old valves that are just worn out. When I went to repair the valves, I found that no one stocks the parts anymore. Is there any easy fix?

Sorry, no. Anytime you go to repair a valve that's more than 20 years old, you're asking for trouble. Some old valves are so simple that you can keep replacing stem washers on them almost indefinitely, but there are many other oddball types that have fallen by the wayside. They weren't made in large enough numbers, and it doesn't pay for hardware stores and plumbing-supply houses to keep repair parts on hand indefinitely. The time you spend locating parts for this plumbing could just as

easily be applied to replacing the valves.

If the bath isn't the primary one in the house, then you can take your time and search the Internet and local sources for the obsolete parts. There are parts providers out there who have made a business out of stocking these hard-to-find items. One is New York Replacement Parts. Its website says some of the parts it stocks date back to the 1890s.

Failing that, consider an all-out overhaul of the bathroom. Yes, that's a lot of work and expense for a bath that may not see a lot of use. On the other hand, at least when it's done you won't have to worry about trying to find out-of-date parts every time a faucet is cranky. **PM**

Got a home-maintenance or repair problem? Ask Roy about it.

Send your questions to pmhomeclinic@hearst.com or to Homeowners Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.



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**PM
Saturday**

Test Location: Itasca State Park, Minn.
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Run Time: 25 minutes/tank

**+ MORE TO DO
IN APRIL**

Watch 'Em Chop

→ Top college lumberjacks meet April 29 in Cobleskill, N.Y., for two days of ax-throwing, log-rolling and chain saw racing at the 65th Timbersports Spring Championship. "We had about 2000 spectators last year," woodsman Joe Lydon says. "People love the chopping disciplines."

Lube the Bike

→ To prep for bike season, silence squeaky chains with mineral-based lubricants like Tri-Flow or Finish Line Cross Country. Brooklyn, N.Y., bike mechanic Mark Simpson says, "WD-40 is good for cleaning grit, but it gums up."

Build a Boat—Fast

→ At the annual Wooden Boat Challenge on April 30 in Bodega Bay, Calif., shop teachers, firefighters and local engineers race to build a seaworthy vessel in under three hours. Event organizer Starr Swindt expects to see plywood sailboats, paddle-wheelers and one-man "potato chip" boats. He also expects half of them to sink.

Scour the Sedan

→ Car Wash Guys founder Lance Winslow says to give cars the "up-and-under clean" when winter ends. "That's where the caked-on crud they use to clear the roads causes rust on the underbody." He suggests using a pressure washer with a 25-degree nozzle to spray the unpainted surfaces with soapy water or degreaser.

+ ONE-DAY PROJECT

Soup-Can Survival Stove

WHERE OTHERS SEE EMPTY TINS READY FOR RECYCLING, PM SEES A SCRAPPY DIY CAMP COOKER. BY WILLIAM GURSTELLE

1 → GET SOUP, TOOLS An 18.8-ounce Campbell's Chunky soup can fits perfectly inside an 18.5-ounce Progresso soup can. With modifications and assembly, the pair combine to form a small cylinder that issues a controlled, hot alcohol-based flame for campsite cooking.

Obtain the soup cans, eat the contents, and rinse the interiors. You also need a hacksaw; a tube of J-B Weld high-temperature epoxy; a yellow bottle of Heet methanol fuel; furnace cement; a ¼-inch-diameter, ¾-inch-long bolt; a ¼-inch hex nut; an 8-inch-diameter round cake pan; a file; a tack hammer; a size 5 sewing needle (or an equally slender nail); and a drill with a ⅜-inch bit.

2 → PREP THE PARTS Use the hacksaw to cut each can down to 1¼ inches in height, and use the file to deburr the edges. Using the tack hammer and the sewing needle, drive 12 holes at equal points around the perimeter of the Chunky can on a parallel line ⅜ inch from the uncut end. These are the gas jets.

Drill a ⅜-inch hole in the center of the Chunky can's end. Use epoxy to cement a ¼-inch nut over the hole on the end's outer face. Do not get epoxy on the threads. Spread a thin coat of furnace cement on the inside face of the Progresso can's end. Center the open edge of the Chunky can inside the Progresso can. Press the Chunky can into the cement. Let it cure overnight.

3 → ADD FUEL Place the stove on the cake pan. Fit a funnel into the Chunky can's nut opening, and fill the can with Heet methanol fuel. (Do not substitute another fuel type.) Screw the bolt in the nut to seal the full fuel tank.

4 → FIRE IT UP Drip methanol over the stovetop and ignite the fuel. The large flame will burn away, leaving a nearly invisible ring of fire between the cans. To cook over the flame, rest a skillet on a pair of bricks or on two lengths of bar stock laid across the cake pan rim. To extinguish the flame, invert a pot over the cans to smother it.



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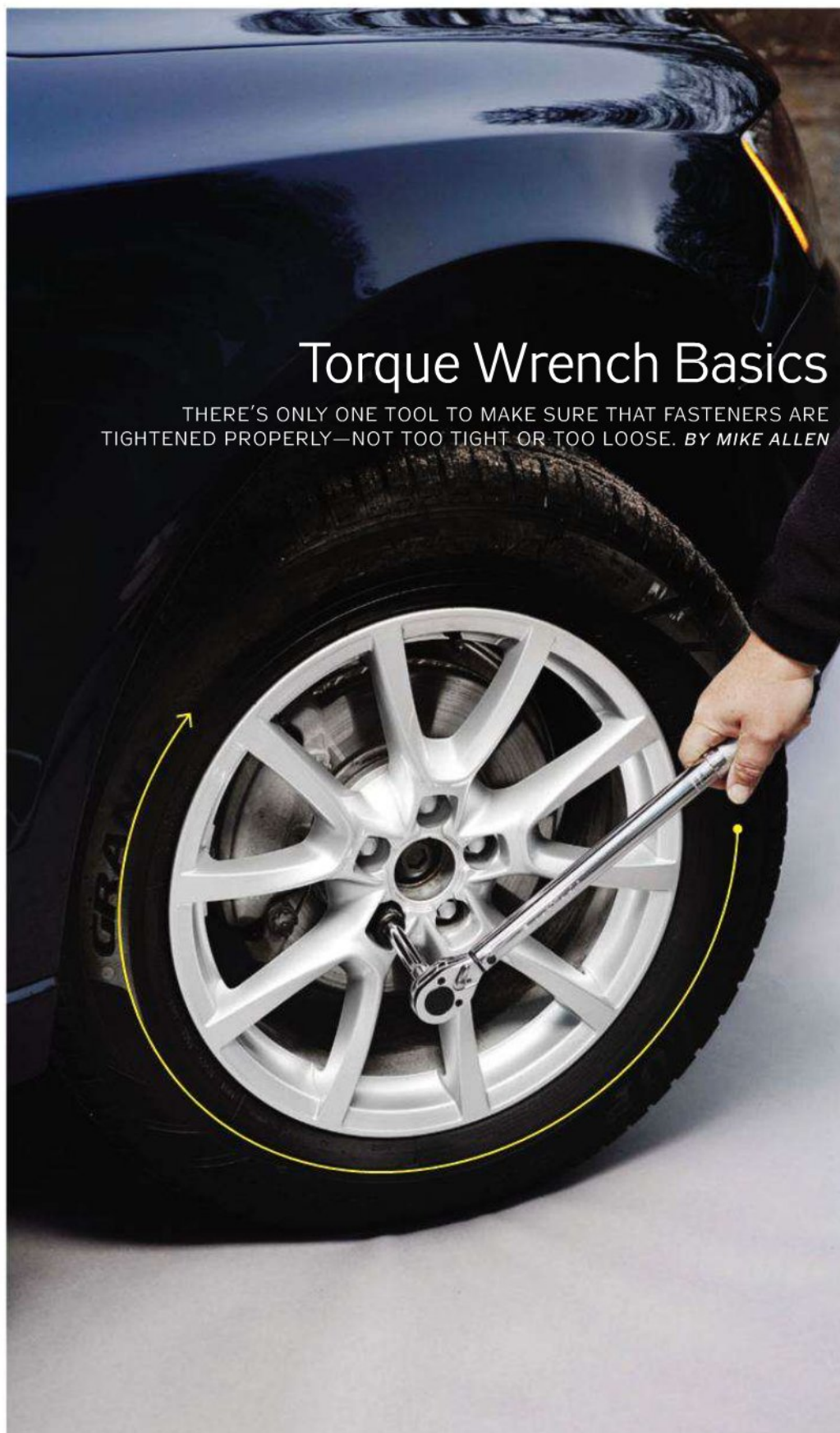
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Torque Wrench Basics

THERE'S ONLY ONE TOOL TO MAKE SURE THAT FASTENERS ARE TIGHTENED PROPERLY—NOT TOO TIGHT OR TOO LOOSE. BY MIKE ALLEN

diy

Auto

Saturday
Mechanic



degree of difficulty
MODERATE



➔ **Breaking loose all five** overtightened lug nuts required totally discharging two full batteries in my cordless impact wrench—obviously, the last person to install that wheel had overtightened the nuts with a powerful pneumatic impact wrench. I installed the lug nuts on the spare with a torque wrench, carefully adjusted to the correct 100 ft-lb, which I looked up in—wait for it—the owner's manual. That process got me the stink eye from the car's otherwise grateful owner—who was convinced that the proper way to tighten the lugs required that pneumatic wrench again, or at least jumping up and down on the end of the lug wrench. In spite of my insistence, I saw him from my living room window a half-hour later, tightening the lug nuts with the car's lug wrench, boosted by a 4-inch length of water pipe slipped over the handle. The squeak as the nuts turned those last few degrees was audible from across the street. Sigh.

Too Much Is Too Much

➔ **Car manufacturers** specify a proper tightening level, a torque value expressed in foot-pounds, for every fastener on your car. Torque is a rotational force applied around a point or, in this case, a nut. Put a 1-foot-long wrench on a nut and apply 10 pounds

Wheel lugs are probably the most common type of torque application.

INSIDE



FUEL-SENDER SMACKDOWN + AN ATTRACTIVE TOOLBOX ORGANIZER + ANIMAL CRUELTY

of force to the opposite end. You're now twisting that nut with 10 ft-lb (distance times force, or 1 foot times 10 pounds). Use a 2-foot-long wrench and apply 50 pounds of force, and you'll have 100 ft-lb, which, happily, is just about as long as most lug wrenches, and as much force as most elbows are happy cranking on.

While most mechanics rely on a well-calibrated elbow to tighten things, it's vitally important that the tightness of a fastener fall within a fairly narrow range. Too loose and there's the danger of the nut or bolt spontaneously unscrewing down the road. Or maybe the gasket or O-ring fitting clamped by that bolt will leak. Too tight and there are other risks: The bolted-together part may be compressed, bent or otherwise damaged. The bolt shank could break, or the threads may strip, providing no clamping force at all. The best way to tighten fasteners is with a device called a torque wrench.

Basics

➔ **Why don't we simply tighten** every fastener of any particular size to the same torque value? Why do we need a shop manual to tell us that one 5/16-inch bolt holding down a valve cover needs 11 ft-lb, while the 5/16-inch stud on the shock absorber needs 20?

Let's discuss what happens when you turn a nut or bolt head. The threads are a form of inclined plane or wedge, the simplest type of tool. As the inclined plane is wedged (turned) into the threads, it applies a force along the bolt's length, effectively making the bolt a tension spring. This tension in the bolt shank clamps two parts together. If the clamping force is greater than the load exerted between, say, the head and the block, those two pieces will never spontaneously get loose.

And the more twisting force you apply to the bolt head or nut, the more clamping force in the joint. So just tighten it until it won't come loose, right?

Wrong. Differences in overall bolt length, the material of the clamped

parts, the presence of a gasket between the two parts, and even the alloy of the bolt itself affect the proper torque. Also, the proper torque value takes into account the friction between the threads, which is the single biggest variable that affects the relationship between the torque applied to the bolt head and the clamping force. Friction arises from the threads as well as the rotating bolt face scrubbing along the stationary workpiece. Overcoming friction can account for as little as a few percent or as much as 50 percent of the force needed while tightening a nut or bolt. And that means that the clamping force can vary widely—not good when you're installing a cylinder head or an intake manifold.

To Lubricate or Not

➔ **Most times, the specified** torque value assumes clean and dry parts. Clean means no dirt, rust, dried-up gasket sealer or anything except shiny metal. Wire-brushing the threads will help remove rust or sealant. Engine fasteners, like head bolts or main cap bolts, are often specified to be torqued with 30-weight engine oil wetting the

threads and washer. If you're installing a fastener that has a dry torque spec, and the threads and bolt face are oiled, you'll need to reduce the torque by 15 to 25 percent, because the slipperier surfaces will decrease friction. Teflon-bearing lubes or moly-sulfide engine assembly lubes can reduce friction enough to require a 50 percent reduction in tightening torque. Even casually substituting a zinc- or cad-plated bolt or washer for an unplated one calls for, respectively, a 15 or 25 percent reduction in applied torque, because the plating acts as a lubricant. Fail to heed this advice and the fastener will be seriously overtightened. You'll either snap it or crush a gasket to the point where it leaks.

On the other hand, rust or burrs on the threads can increase friction enough that a fastener tightened to the specified value won't provide sufficient clamping force. The shop manual will specify whether the fastener is supposed to be dry or lubed. In either case, prep your bolts. Don't forget that residue from the parts washer or that pie tin full of kerosene you're using to clean parts has oil in it. Even a quick blast of compressed air to dry off a fastener will

	TOOLBOX TORQUE TYPES
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There are two commonly used types of torque wrenches. Choose a wrench whose upper limit is roughly double the value of most of the torquing you'll do—don't use a 0-to-250-ft-lb wrench to tighten valve covers to 8 ft-lb.

BENDING-BEAM

[1] This is the wrench for those who don't regularly need a torque wrench. The large center beam bends as you apply torque, while the unbending pointer beam lets you read the torque directly. If it goes out of calibration, simply bend the pointer back to zero with a pair of pliers. The single biggest disadvantage is that your eyeball has to be parked directly above the pointer

while you read the scale, which is tough in hard-to-reach places.

MICROMETER "CLICKER"

[2] This pro-grade tool is preset to the correct torque and will click tactilely and audibly when it reaches the correct torque. It's highly repeatable and accurate, but should be returned to zero after every use. Even so, it should be calibrated regularly if used for critical

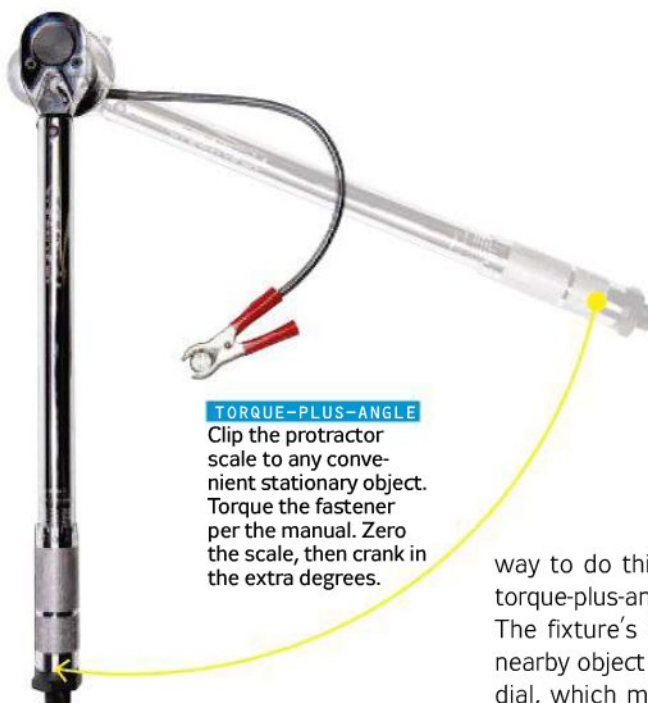


parts like suspension and internal engine fasteners. Don't use your torque wrench like a ratchet for disassembly—save it for final assembly.

leave an oily film behind, affecting ultimate torque. If you're really fastidious, clean up with some aerosol carb or brake cleaner, followed by more air. If you've used grease or anti-seize compound to keep the brake discs from seizing to the hubs, take care not to contaminate the studs or lug nuts.

Torque-Plus-Angle

➔ **Increasingly, critical fasteners** like cylinder-head bolts, engine-mount fasteners and intake plenum bolts require what's referred to as torque-plus-angle tightening. Due to inconsistencies in the friction between the threads and bolt face, conventionally torquing a fastener isn't consistent enough. A few percentage points of difference in friction, due to irregularities in the threads, a burr, rust or old thread sealer, can multiply into a huge variation in the fastener's tension. That can lead to spontaneous dismantling of the joint. The tightening spec for these fasteners requires two stages. The bolt head or nut is first



TORQUE-PLUS-ANGLE

Clip the protractor scale to any convenient stationary object. Torque the fastener per the manual. Zero the scale, then crank in the extra degrees.

tightened—in a normal crosshatch sequence if there are more than two—to a prescribed torque value; then, again starting with the first bolt, to a second, higher value. Only then should it be turned, in a single smooth move, an additional number of degrees. The only

way to do this accurately is with the torque-plus-angle fixture (shown at left). The fixture's arm is clipped to some nearby object to anchor the protractor dial, which must be returned to zero after the initial torque is applied. Then the wrench is turned the specified additional rotation. Again, this should occur in the customary sequence for multiple fasteners.

Critical fasteners—cylinder-head bolts are the poster child here—are so difficult to properly tighten that not only does the manufacturer specify torque-plus-angle tightening, the bolt is a one-time-use item that has to be discarded if it's ever removed. These torque-to-yield bolts generally have a necked-down straight section between the threads and the bolt head. The initial torquing stretches the bolt along its length nearly to its limit of elastic deformation. If you unscrewed the bolt at this point, it would return to its original length. Apply the extra rotation and the bolt stretches to its plastic deformation region, where additional stretching of the bolt yields no additional clamping force but the bolt won't return to its original length later.

This method assures that all of the bolts clamp the two parts together with nearly identical force so critical things like head gaskets won't leak. You're probably wondering why engineers don't simply specify larger bolts that can apply enough force without permanently deforming. Those larger bolts can be overtightened, and too tight is just as bad or worse than too light.

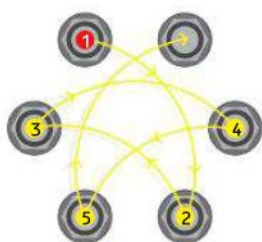
Finished torquing the wheels or cylinder head? Don't forget to save the torque wrenches' calibration by returning the micrometer scale to zero before you stash it in your toolbox. **PM**



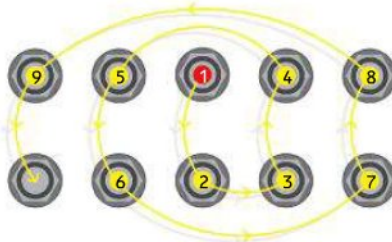
SHOP TECHNIQUE

TIGHTENING PATTERNS

Whenever there are more than two fasteners securing a part, it's important to alternate the tightening among them. Here's the correct procedure: Start all the bolts or nuts a few threads and then run them hand-tight. Often, the shop manual will show a specific tightening sequence. Tighten mildly by hand, then to the torque spec.



1. Circular patterns of bolts, typically the lug nuts on wheels, should be tightened not in a circle, but in a crisscross or starfish pattern.



2. Larger, oblong parts like cylinder heads often have a specific sequence for proper tightening, generally starting near the middle and circling around.

KNOW THE BOLTS

Markings on bolt heads designate the bolt's strength class. Don't ever use an ungraded bolt with a blank head on anything more highly stressed than a barbecue. SAE Grade 5/DIN 8.8 bolts are appropriate for most uses, while SAE Grade 8/DIN 10.9 bolts are higher-strength fasteners for critical applications like suspension parts and connecting rods. There are many specialty fasteners that have unique markings as well.



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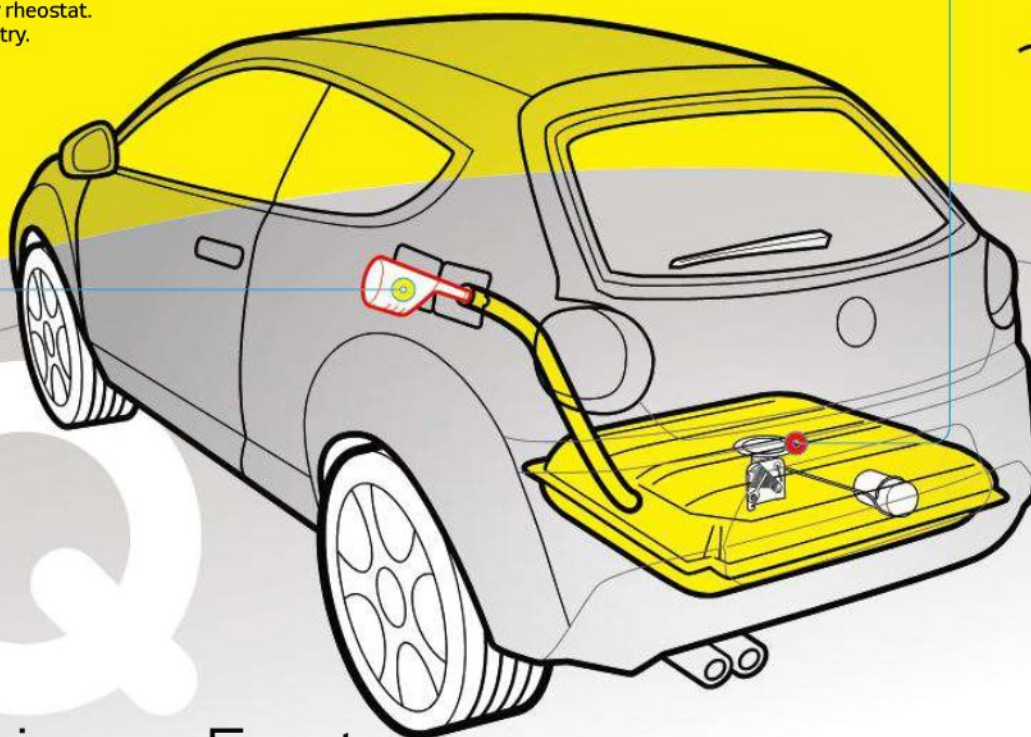
Q+A

GM ADDITIVE

GM's Fuel System Treatment Plus is claimed to contain an additive that prevents corrosion on the fuel-level sender rheostat. It's worth a try.

THE SENDER

Alcohol and water in the gasoline can corrode the fuel-tank sender's Nichrome wire rheostat.



Running on Empty

The fuel gauge in my Chevy pickup has started to act weird. Sometimes, after I fill the gas tank, the needle on the gauge reads empty for about 100 miles, then springs to the expected position. This started a few months ago, but is occurring with greater frequency. The dealer told me I had to replace the fuel pump at a cost of over \$800. For that kind of money, I can use the trip odo. Any cheaper solutions?

A This is almost certainly caused by alcohol (now universally present in pump gas at concentrations of up to 10 percent) corroding the electrical contacts in the fuel pump sender. A float inside the tank moves an arm up and down, which makes a contact wipe over a wirewound resistor. The changing resistance is mirrored by the dash gas gauge.

When the contacts get corroded, there's only an intermittent connection between the arm and the resistor. The sender is mounted inside the tank on the same assembly as the fuel pump, and for many vehicles, accessing the sender means draining and removing the tank. That \$800 tab represents the worst-case scenario.

Not all tanks have to be removed to access the pump/sender module. Unfortunately, yours does. Sometimes you can simply get a new sender instead of replacing the entire fuel pump assembly. GM lists a replacement fuel gauge sender in its parts list, and there are probably aftermarket senders for even less. My suggestion

is to find an independent shop rather than go to the dealer.

But wait—there's more! GM has a product called Fuel System Treatment Plus (PN88861011) with an additive that supposedly will prevent and even reverse the corrosion. Reports from the field are good, and the fluid doubles as a fuel-system cleaner, so it's worth a try before you start draining the tank and replacing a lot of expensive parts. Yes, you people with non-GM cars with intermittent gauges could try this additive as well.

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CAR CLINIC Q+A

Dental Hygiene

Over the summer and fall, I typically store my SUV in a garage near a wooded area. Since the vehicle is used very little, mice have found my parked SUV an ideal place to set up house-keeping. I've found them in the engine compartment, air-conditioning ducts and interior. What can I do to keep my SUV or any other stored vehicle mouse-free?

This question comes up regularly, usually in the fall, when the rodent population is looking for a warm place to winter, or when it starts to burgeon in the spring. Either way, mice can do serious

damage. They'll eat wiring, rubber hoses or bushings and build nests in odd places. A lot of wiring in newer cars is made from soy-based plastic instead of petroleum-based chemicals, and it seems to be particularly attractive. The little critters don't actually eat the rubber or insulation, they use it to wear down their constantly growing teeth. Commercial rodent traps and poisons aren't that effective out-of-doors. I prefer moth crystals, but they make your ride smell like Auntie Charlotte's storage closet.

Others report good results from ordinary dryer sheets—the perfume apparently is unpalatable to small furry guys. To use the moth crystals, just wrap 3 to 4 tablespoons in some aluminum foil and leave one packet in the engine com-



MIKE'S TOOLBOX

MAGRAIL TL

I must have had a half-dozen different socket rails in my assorted toolboxes. And they all had something wrong with them. Too tight, too loose, too ugly...

Then I saw the Magrail TL organizer. With amazingly powerful neodymium magnets inset into anodized aluminum rails, it's strong enough to anchor to sheet steel right through a vinyl drawer liner. Easily moved plastic posts in 1/4-inch, 3/8-inch or 1/2-inch sizes locate the sockets or tools along the rail, and the magnet is strong enough to hold up a set of Vise-Grips confidently. I've redone my toolbox with them and put one on my press brake and drill press to hold tools and chuck keys. In spite of the powerful magnets, sockets tip off the posts readily into your greasy hands. They're available in assorted lengths and colors from \$16.30 at vimtools.com.



PHOTOGRAPH BY MARKO METZINGER

partment and one in the passenger compartment. Ditto for the dryer sheets: one underhood and another in the passenger compartment. Under the carpet is a nice, unobtrusive place. Or, tie it to the mirror like an air freshener. On the other hand, if I had this problem around my present house, I'd just get a cat and not feed it very often.

Hot Time Tonight

My father owns a 2000 Buick LeSabre, and we have been having a dispute over the operating temperature of the engine. He knows that the thermostat is set to open at 195 degrees, so in the winter he watches the digital thermometer function from the onboard temperature display like a hawk. For most of the time, the temperature will hover around 187 to 189 degrees when the car is fully warmed up. He says it has to be at 195 or the car is running too cold. So, every winter he sees the 187 to 189 reading on the digital thermometer and takes the car back to Buick for a new thermostat.

I tell him he is wasting his money and that the 8-degree difference shouldn't cause any problems with the engine or the interior temperature. I've also made the point that if he didn't have the digital readout, he wouldn't notice it. Who's right?

That 195-degree rating represents sort of the middle of the range where the thermostat opens, but still, 8 degrees is outside of its normal range. So, in some sense, he's right.

However, the coolant that flows into the thermostat is generally several degrees hotter than what the gauge displays. That's because the thermostat housing bridges the coolant's path from the engine to the radiator—the hottest point—while the gauge temperature sender reads the coolant in the cooler intake manifold.

To resolve this controversy, I'd temporarily attach a mechanical sender to the port in the intake where the electrical sender goes, and confirm the accuracy of the Buick's readout. You might also try getting a temperature reading with an IR noncontact thermometer at both the 'stat housing and the sender.

Or better yet, your dad should just

relax—his car is working normally, as far as I'm concerned.

Idle Hands

My 1998 Chevy S-10 will rev up to around 1400 rpm when at idle. I have noticed that if I drive it until the heater blows out hot air, stop, shift into neutral and wait for a minute or two, the engine rpms slowly decrease to 600 and stabilize. If I shut off the engine, wait for a minute or two and then restart it, the idle speed will hover around 800 rpm. I don't get any Check

Engine lights or anything. Could this be the result of a vacuum leak, or is it something more complicated?

Ohhh, so many things...

A sticky idle air control valve, or sticky throttle blades, could be the culprit, and both problems can be addressed with a proper cleaning. There's a Saturday Mechanic on the PM website detailing how to do this: popularmechanics.com/throttleclean.

Other potential issues could be vacuum or metered-air leaks, or even aged, rock-hard injector O-rings. Check

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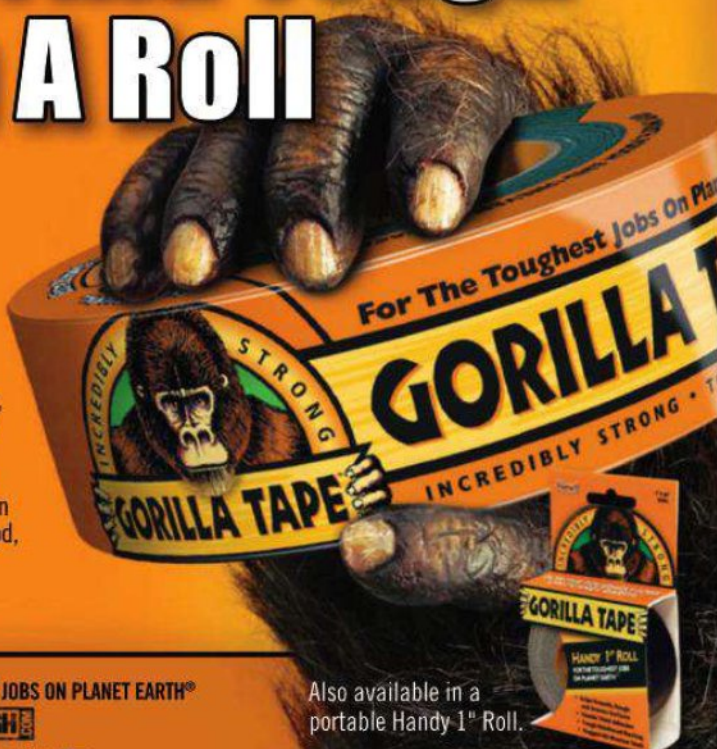
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PM DIY AUTO ///
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the ductwork between the mass-airflow sensor and throttle body. A bad engine-coolant sensor could be telling the ECU that the engine hasn't warmed up, although that should set a trouble code.

Even though the Check Engine light isn't on, I'd start with a scan tool and look at stuff like idle vacuum, long-term fuel trim, intake air temp, coolant temp and other parameters to see if any of the values don't make sense. My best guess, however, is a vacuum leak, because your truck is about the right age for the plastic and rubber vacuum lines and fittings to get hard and stop sealing.

Losing Your Head

I have a 1995 Buick Roadmaster that was parked for a couple of years. The battery, of course, went dead, as did the key fob. I installed new batteries in the car and fob, but the car still won't start because the factory alarm won't reset with either the fob or the ignition key. The dealer says they can fix it, but I would have to have it towed 50 miles to the facility. How can I reset the alarm and avoid the expense of the dealer and the tow?

You need to reprogram the key fob's transmitter to the car's receiver. There's a hidden connector inside the passenger-side interior bodywork back by the tailgate.

- Ground this programming connector by jumpering the terminals together. The system will verify this has occurred by performing a lock all, unlock driver's door/unlock all, and finally cycling the tailgate lock.

- Press any key on either transmitter. This step programs that particular transmitter to the receiver.

- The system will verify by performing the same lock/unlock, lock/unlock cycle. The hardest part will be opening up the bodywork to access the connector. Any independent repair shop should be able to look up the procedure on Alldata or Mitchell. Or try it yourself; the only tools you'll really need are a Phillips screwdriver to

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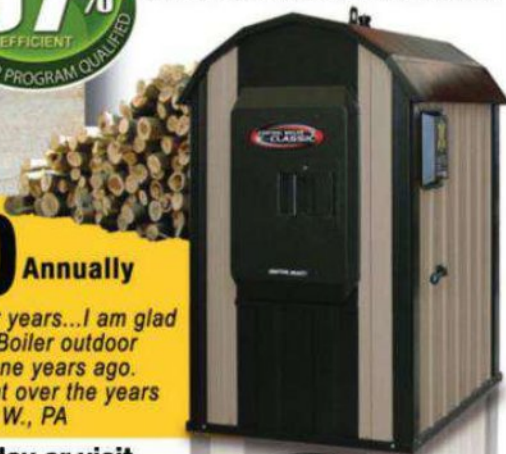
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remove the trim and access the connector, and a paper clip for a jumper.

Note that this procedure is specific to your 1995 Roadmaster; other vehicles resync their locks in different ways. Those of you who don't own this particular make/year/model of Buick should check the shop manual on alldatadiy.com or a printed aftermarket service manual. A few vehicles reveal this information in the owner's manual.

Shiftless

I have a 1988 Toyota 4Runner, with an automatic transmission that I intend to keep for, hopefully, a long, trouble-free relationship. I pull a lot of trailers and rack up plenty of highway miles, so I'm keen to save transmission wear and tear. So I always anticipate the gear changes and back off the accelerator just before a shift to relieve pressure on the transmission. And I tell anyone who's driving my truck to do the same. Am I actually saving the gearbox, or have I just been an annoying backseat driver?

Your transmission is designed to make gear changes without any intervention from you. Chill out and let everybody else who drives your truck relax. The multiplate clutches that engage and disengage the assorted gears are very robust and long-lasting. Lifting off the gas until the tranny shifts, then putting your foot back into the throttle, will not substantially lengthen the life of the gearbox internals. The reversal of engine thrust from feathering the throttle will, on the other hand, prematurely wear out the motor mounts, the constant-velocity joints, the driveshaft splines and U-joints and your throttle cable.

Since you do a lot of towing, my only suggestion is to add an auxiliary transmission cooler, which will keep fluid within its normal temperature range.

Dog Day Afternoon

I need some technical expertise. I built a custom dog/cargo carrier for the back of my SUV. It is made of open metal grating and sits above the rear bumper and behind the tailgate. Is there enough airflow to prevent poisoning my dog with carbon

monoxide? The exhaust exits behind the right rear tire. Any advice would be greatly appreciated.

My advice is to give up your dog for adoption. Seriously.

Okay, the carbon monoxide issue is a non-starter, because the CO output of a modern OBD-II vehicle is microscopic. It's so little that it's almost impossible to commit suicide by running a car inside a closed garage anymore. But still, I can't imagine putting a family member out there where there's no protection whatsoever from a rear-end crash. I'm not even comfortable with putting pets in the bed of a pickup on any but the nicest days. Would you put your wife and kids out there at 70 mph on a hot day? Didn't think so. **PM**

Got a car problem?

Ask **Mike** about it. Send your questions to pmautoclinic@hearst.com or over Twitter at twitter.com/PopMechAuto or to Car Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.



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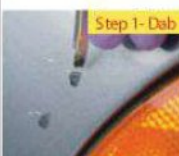


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HOME SURVEILLANCE GEAR HAS GOTTEN SMARTER AND MORE CONNECTED, BRINGING AIRPORT-GRADE SECURITY TO THE HOME FRONT. BY GLENN DERENE

➔ **As I'm writing this** in the POPULAR MECHANICS offices in New York City, I'm looking out the front window of my home in Connecticut. There's no one there right now, but only a few minutes ago, I got an alert from the security camera I've got suction-cupped to the inside of the glass. In fact, every day I get an alert around 4 pm; that's generally when the mailman comes for his daily drop-off. But today, I also received a mid-morning message that I didn't expect. I checked the video clip on my phone to discover that UPS had left a package on the porch.

Like many people with surveillance systems, I first got interested in the technology as a home security measure, but over time my relationship with the system has become a bit more complex. Having a constant remotely accessible video link to your front door gives you a sense of connection to what's happening at your house that goes beyond simple peace of mind. Wondering how often

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your dog runs out the dog door? Curious about who's leaving all the Chinese menus in your mailbox? Want to know if there's snow on your driveway when you're on vacation in the Bahamas? Modern home surveillance cameras combine software, hardware and cloud-based services to satisfy humankind's instinctual (and occasionally obsessive) curiosity about the status of our homes.

And the software and cloud parts of the equation have gotten surprisingly sophisticated in the past few years. Since *POPULAR MECHANICS* last discussed the technology, several consumer-grade cameras have come to market that integrate video analytics software once limited to governments and industry. "All the systems we're seeing now in cities and airports are starting to trickle down to the home," says James W. Davis, an expert on video surveillance technology from Ohio State University. "And it goes beyond security. There's plenty of research into using these systems to monitor and help the elderly in their homes."

When choosing a home camera sur-

veillance system, you basically need to ask yourself two questions: How much do I want to spend, and how smart do I want my camera to be? As you might expect, the two questions are interrelated. I tested four surveillance setups ranging from \$179 to \$650 and found that while many of the basic technological concepts were the same, no two systems had identical features. I also found that if you want all the remote-access, cloud-based bells and whistles, you're going to get sucked into paying a monthly or yearly fee.

The Simple Setup

➔ **The Avaak Vue** is the cheapest system of the bunch, and it is also the easiest to get up and running. The cameras are battery-operated and completely wireless. They communicate with a hub that plugs into your network router, and all video is viewed through a secure Web page. Even mounting the Vue cameras is easy: They have an ingenious peel-and-stick base that the cameras attach to magnetically. The downside is that Vue cameras are pretty low-resolution and aren't really that smart.

There are two systems available: The basic CI system can be programmed to record at certain times of day, but the cameras don't "pay attention" to the video at all. The slightly more expensive CM cameras can detect motion and send alerts via e-mail or SMS. But if your camera is aimed at a relatively high-traffic area (say, the street in front of your home), you have to dial down the sensitivity of the motion sensor in the software. Other systems are more sophisticated, but none approach the Vue for idiot-proof setup. Remote viewing from a computer is free, along with a limited number of motion alerts, but access from smartphones and unlimited alerts require a \$20-per-year plan.

Polished Package

➔ **Somewhere in the middle** of the continuum between ease of use and sophistication is the Logitech Alert system. It uses your home's power lines both for power and to connect to your network (a plug-in receiver needs to be placed in an outlet near your router to transmit the signal from your home wiring). Unlike the Web-based Vue system, the Alert uses software on your home computer that can be complemented with a range of Web services. The Alert's software is definitely the most polished



HEAD-TO-HEAD

WHICH CAM DOES WHAT?



System	AVAAK VUE	LOGITECH ALERT	CERNIUM ARCHERFISH	SCHLAGE LINK
Pricing	Basic one-camera system is \$179; one-camera motion-detection system is \$199. Additional camera is \$99 to \$129 (outdoor cam is \$159).	One-camera indoor system is \$300; one-camera outdoor system is \$350 (additional cameras range from \$230 to \$280).	Solo indoor/outdoor cameras cost \$399 each; Quattro four-camera setup costs \$1399.	Camera is part of a \$644 system that includes Schlage digital locking system and one lighting controller. Additional cameras are \$169.
Resolution	Up to 640 x 480 pixels	960 x 720 pixels	640 x 480 pixels	640 x 480 pixels
Networking	Proprietary wireless	Power line	Wi-Fi	Proprietary wireless
Mobile alert	Limited alerts are free; unlimited are \$20/year.	Remote viewing is free; alerts are \$80/year.	Remote viewing is free; analytics and alerts start at \$6/month.	Alerts from lock (not camera) are \$9/month.

of the bunch. And its 720p video signal is the crispest as well. The software allows some limited programming of the cameras, such as drawing boxes around trigger areas or sections of the video frame to ignore. For example, you can draw a "pay attention" box around the area right in front of your door but tell the system to ignore the street behind it—that provides a far more accurate record of who comes up to your house, rather than just who passes by it. The downside is that Logitech hides much of the best functionality (e-mail and text alerts, smartphone control) behind a paywall of \$80 per year. That's a bit disconcerting after you've already shelled out \$300 to \$350 for the system.

Camera With Brains

➔ **The most sophisticated** camera analytics comes from a company called Cernium, which got its start selling more advanced stuff to airports. Cernium's Archerfish Solo system has much of the same "regioning" functionality as Logitech's cameras, but Solo can also perform image analysis to tell the difference between a person and a nonperson or distinguish a vehicle from other objects. That reduces the number of garbage alerts and lets you zoom through a day's footage in moments. Unlike other cameras, the Solo requires no separate base station—it communicates directly with Archerfish's cloud-based service using either your Wi-Fi network or a direct Ethernet connection (as with other systems, the free basic service lets you check in remotely, while access to the more sophisticated functions requires a monthly fee). The Solo sent fewer false alerts than the Logitech camera, but it was the most frustrating to set up. Getting the software to recognize the camera took forever, despite the camera's indicator light signaling that it was connected and functioning. Also, my testing showed that although the camera is impressive in its detection abilities, there are still enough false positives (it thought my son's teddy bear was a person) to make one question the analytics.

The Integrated Solution

➔ **Finally, I tried** the Schlage Link system, which is a bit of an outlier here, as it is not a pure camera solution. In fact,

the Schlage camera is an accessory in the larger Link system—you can buy it individually or as part of a home security and automation package that also handles locking, lighting and thermostats. As it turns out, the Link camera is the least "intelligent" in this lineup, yet the overall system is the most sophisticated. The Schlage Link system is ostensibly a DIY package, but because it is centered around the company's digitally controlled door locks, if you are at all uncomfortable with the process of lock installation, you may want to call a locksmith. (The Link locks fit into a standard lock bore.)

The camera allows remote monitoring via a Web page or smartphone app (as with other providers, there's a fee for cloud services), but it has no event detection or analytics. The Link lock, however, can record, and alert its owner when anyone enters the house. This gets pretty interesting: You can give your kids a separate code to punch into the lock's keypad and the system will alert you when they get home. If you're having work done on your house, you can give the contractor a separate key code that only works during a prescribed time of day. And you can use the remote access to turn on the lights and open the door from a computer or smartphone and let people inside while you're away. In this scenario, the camera acts as a remote verification system—playing backup surveillance for the lock. If someone is at your door, you're able to see who it is before letting him or her inside.

For some, computer-accessible locking might just be a bit too creepy. (What about hackers?) But it's worth remembering that many people already use a remote control to open their garage doors, and that for every hacker who can crack a computer code, there are probably thousands of thieves who can pick a standard door lock.

So after several weeks of testing various systems, no one attempted to break into my home—then again, nobody had attempted a break-in before, either. The lesson I've learned from my surveillance experiment is that when I'm away, my house is actually quite a boring place—which, I suppose, is exactly as it should be. **PM**

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Q The Next Wave of 3D TVs

I read about new 3D TVs that use the same kind of glasses as a 3D movie theater. What's the deal with those?

A For the past few years, the electronics industry has been unrestrained in its enthusiasm for 3D TV. Okay, positively giddy is more like it. But who can blame manufacturers for wanting to get in on the action? After all, their friends over in the movie industry have been using 3D's inflated ticket prices to pad their bottom lines for a couple of years now. And with breakthrough hits like *Avatar* mak-

ing use of the format, customers have coughed up the extra cash.

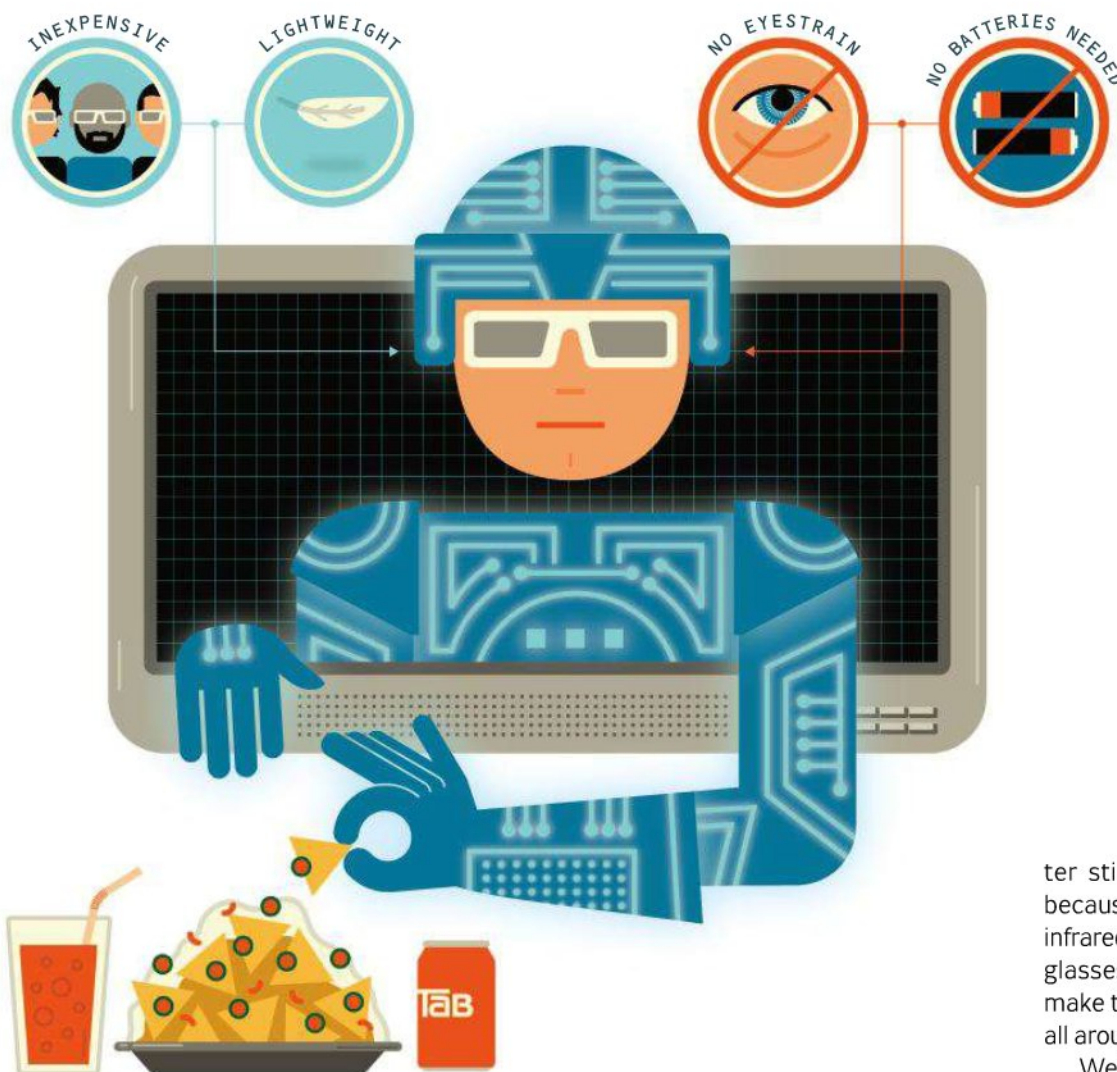
But the 3D TV industry has a problem on its hands. The current technology used to power 3D sets is flawed. Pretty much every 3D TV available up until now has relied on what are called active-shutter glasses—battery-powered spectacles that work by blacking out alternating eyes at a rate of 120 times per second. This is fast enough to deliver different images to each eye without users consciously noticing what is happening. The result is an often-stunning high-definition 3D image, but it comes at a steep price—and I'm not just talking about the \$100 or so the glasses cost. These gizmos require batteries, are heavy enough to cause discomfort (we've got the red marks on our noses to prove it) and, for some users, can be positively nauseating. As part of a recent 3D TV test, I used the glasses to watch

TV for 4 straight hours, and walked away feeling woozy and exhausted. Even the TV-makers I spoke to called me brave for enduring this.

These flaws could enter deal-breaker territory for all but the most adventurous early adopters—which is why I'm so excited about the new breed of 3D TVs that ditch active-shutter glasses.

At the Consumer Electronics Show in January, major manufacturers such as LG and Toshiba announced sets that use the same "passive" 3D glasses found in movie theaters. These glasses are inexpensive enough to let a casual user outfit a party, and they have no batteries or moving parts. And because they don't flicker on and off hundreds of times per second, users are far less likely to walk away with a case of the woozies. Better still, a Toshiba rep told me that because the new TVs don't require an infrared transmitter to sync up with the glasses, they are actually cheaper to make than active-shutter 3D TVs. Wins all around!

Well, almost all around. This technol-



ogy is nothing new—as I said, you’ve probably worn the same glasses at 3D theaters—so one has to wonder why TV manufacturers haven’t built it into more sets before. One major reason: The glasses can’t deliver a true high-definition picture using existing television sets.

With active-shutter glasses, each eye takes turns looking at the screen, and when they do, they see all 1080 lines of high-def crispness. With passive glasses, the pixels are split between both eyes, meaning the resolution is effectively cut in half.

But with any evolving digital technology, no flaw is likely to last forever. RealD (the same company that provides the 3D tech for many movie theaters) has teamed up with Samsung to deliver sets that have it both ways—passive glasses and full high-definition. They’re calling the tech RDZ, and it works by rapidly switching the TV’s screen between full-resolution left- and right-eye images. This is similar to how active-shutter glasses work, but because the left and right images are circularly polarized in opposite directions, they can be directed to different lenses on the polarized passive glasses. At press time, Samsung had yet to announce pricing or availability for the new TVs, but we expect them to appear sometime this year. Of course, not even these new sets will fix the other problem facing 3D TV: a scarcity of content.

Zoom Stuck

I don’t know what I did on my laptop, but I somehow caused my screen to zoom in, and I have no idea how to zoom it back out. Help!

Oh, screen zoom. You’re great for getting a close look at pictures and text, but

tech tip

Want to send a link to a particular part of a YouTube video?

Add “#t=”, followed by the target time, to the end of the URL. So if you want the link to zoom clickers to 1 minute and 23 seconds into the video, finish off the URL with “#t=1m23s”.

if accidentally activated by an unaware user, you can be a nightmare—and that goes for both Mac and PC users. Mac-heads can undo the damage by holding down the Control button, then using fingers to swipe from the top of the trackpad to the bottom. To rezoom, simply swipe upward. If you’re worried about getting stuck in zoomed-in purgatory, you can disable this feature—go to System Preferences, click Trackpad, and then uncheck the Screen Zoom box.

Windows calls the feature Magnifier, and it can be found in the Ease of Access settings in the Control Panel. If you’ve turned it on by mistake, look for a magnifying-glass icon in the upper left corner of the screen. Click it and follow the dialog box’s instructions to exit the mode. Then go to the Ease of Access settings and deselect Turn On Magnifier. **PM**

Got a technology problem?

Ask **Seth** about it.

Send your questions to pmdigitalclinic@hearst.com or over Twitter at twitter.com/sethporges. While we cannot answer questions individually, problems of general interest will be discussed in the column.



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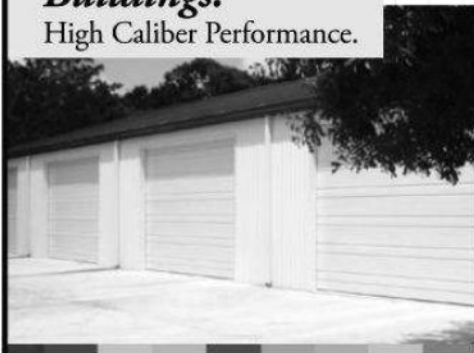
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This Is My Job

✱ ARBORIST

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Location: PORTLAND, ORE.

Age: 28

Years on Job: 6

✱ Will Koomjian is totally comfortable halfway up a Douglas fir that's swaying 10 feet off center. "It gets you in the gut, but you learn to enjoy it," he says. Koomjian's day job is pruning trees for Peacock Tree Preservation, but in 2007, he co-founded Ascending the Giants, a nonprofit that documents the world's biggest trees of each species. Koomjian has climbed such record holders as a 144-foot, 800-year-old Sitka spruce in Oregon's Cape Meares National Wildlife Refuge. "If you want to understand a tree, you have to go into the canopy," Koomjian says. "People think it's simple, but in fact, it's extremely complex structurally. It's kind of like a secret world."

— EMILY HAILE

1. RIGGING

To climb a tree, Koomjian launches a throw line and hoists himself up using tree-climbing rope and, if the tree is tall, a cammed ascender. He uses rope for balance and positioning within the canopy. "A skilled tree climber can stand on branches much too small to support his weight," he says.

2. SADDLE

Koomjian sits in a German-made climbing saddle. "The treeMotion is a sports car of a saddle," he says. "It's light, snug and

extremely responsive." A cord called a bridge connects independent, adjustable loops around the thighs, allowing Koomjian to shift his weight easily. "The bridge is long and low on the body, so it gives you greater range of motion than traditional saddles," he says.

3. CLOTHING

Koomjian's canvas pants have pockets that sit below the saddle's straps so he can reach them. A lightweight (0.84 pounds), sturdy helmet—designed to withstand significant top and side impacts—protects his head.

4. CHAIN SAW

To trim branches, Koomjian uses a Stihl MS 200 T chain saw. At 7.9 pounds, the 2.1-hp machine is the best he's found for his job. "For power

per ounce, it's very efficient," Koomjian says. A breakaway attachment allows the saw to fall free of its lanyard if the tool gets snagged. "Better to drop a saw than have a big piece of falling wood throw you off balance," he says.

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